High Intensity Transplanting Increases Yield in Indigenous Aromatic Rice, *Tulaipanji*- a Case Study

Dhiman Sen[1*] and N. C. Sarkar[2]

[1]School Para, Kaliyaganj, Uttar Dinajpur, West Bengal (733 129), India

[2]Department of Agronomy, Nagaland University, SASRD, Medziphema campus, Nagaland (797 112), India

Article History

Manuscript No. 16

Received 22nd April, 2010

Received in revised form 25th April, 2010

Accepted in final form 1st May, 2010

Correspondence to

**E-mail:* sendhiman@rediffmail.com

Keywords

Aromatic rice, *tulaipanji*, high intensity transplanting, yield

Abstract

Tulaipanji is indigenous aromatic rice adapted in a small pocket of West Bengal, India. It is popular for its medium-long slender grain with high amylose content and strong aroma even after parboiling. Farmers traditionally grow this cultivar in poor fertile soil under late sown and moisture stress condition to produce best quality harvest. However, such stress factors are responsible for low average yield. The modified transplanting technique, High Intensity Transplanting can increase average productivity even after maintaining traditionally followed stress conditions to produce quality aromatic grain of *tulaipanji*.

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1. Introduction

Tulaipanji is a one of the oldest indigenous aromatic rice varieties adapted in a small pocket of North Dinajpur district of West Bengal, India. It is medium-long slender grain with an average length 5.5 mm, length/breadth ratio 3.4 and elongation ratio 1.6. Cooked rice is tasty, good in texture, bright in appearance, non-sticky and friable due to high amylose content (28.3%). It also contains 7.3% protein and comparable quality parameters like 77.1% hulling , 65% milling, 54.2% head rice recovery and alkali value at 4.0 (Sen, 2008). The cultivar has potential trade value and is of consumers' choice because of its pleasant, strong and stable aroma. So, it is very good as scented plain rice for the preparation of *polao*, fried rice, *biriyani* (special rice preparation with vegetable or non-vegetables like chicken, mutton, pork and beef), sweet dishes; grain dust for various local sweet dishes (like *pithe*, etc.). Presence of aroma in raw as well as parboiled rice is a very rare character. In general, aromatic rice loses its strong aroma and becomes mild after parboiling. One of its distinct features is that aroma has been found stable and strong in the parboiled rice grain even up to one year.

Being locally adaptable cultivar, its cultivation practices do not need any special emphasis. It is low input responsive cultivar, so management does not cost to the farmers (Sen et al., 2005). Traditionally it is grown without using any fertilizer. Low soil fertility and moisture stress are generally maintained in the growing field. Sowing as well as transplanting is done under late to very late condition. These specific traditional management practices develop a stress environment for the plant and seem essential to produce best quality aromatic grain of the cultivar. However, on contrary, it leads to poor average yield. Due to very low productivity (about 1.0 to 1.5 t ha^{-1}), farmers had been ignoring this cultivar. Now-a-days, farmers are either using fertilizers to increase productivity compromising with its quality or preferring other non-aromatic high yielding local or outsourced cultivars to mix with *tulaipanji* for getting higher yield and profit at the expense of quality (Sen and Kar, 2006). To encourage farmers to avoid these unwanted practices, major emphasis should be given to enhance its productivity even after maintaining specific traditional management practices to harvest quality produce. Keeping these in view, an attempt was made to find the best possible agro-technique suitable for the area to increase the yield of this cultivar.

2. Materials and Methods

At first, various *tulaipanji*-growing fields were visited during 2004 to observe the growth habit, morphology, growing conditions, management practices, etc. At the same time, discussions were made with several growers to get detailed information about it. From the various basic observations, a new transplanting technique termed as High Intensity

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transplanting (HIT) was developed. Under traditional practice 3-5 seedlings are transplanted, whereas in new transplanting technique 12-14 seedlings are transplanted with same spacing as conventional transplanting. In 2005, the variety was raised with HIT in the few fields to get some initial feedback. After some outstanding responses, an experiment was set up in 2006 with two trials in two different farmers' fields having two different growing conditions viz. in the first field, farmers practised low dose of chemicals with comparatively early sown condition; and in the second field, organic low input was used in late sown condition . Statistical analysis could not be made possible.

The preliminary case study followed by field experiment was taken place in the farmers' field at two sites in *Kalianganj* in North *Dinajpur* district, West Bengal, India. Soils of the experimental fields were silty loam in texture with pH 6.2 and 6.5, respectively. In both the fields, jute-*tulaipanji* rotation is traditionally followed. The cultivar generally matures in 120-125 days. For both the transplanting techniques, each field of one *bigha* (1333.3 m^2) was used where the cultivar was transplanted at 15 x15 cm^2 spacing replicated thrice.

2.1. Experiment 1 (Recent practice)

In the first experimental field, soil is silty loam in texture with pH 6.2, low in organic carbon (0.31%), phosphorus (40 kg P_2O_5 ha^{-1}) and potash (121 kg K_2O ha^{-1}). Here based on the experiences in raising crops, farmers normally applied a low dose of fertilizers mixture of 8 kg SSP, 3 kg Urea and 3 kg MOP per *bigha* (1333.3 m^2). Sowing and transplanting were done on 16^{th} July and 1^{st} September, 2006, respectively.

2.2. Experiment 2 (Traditional practice)

The experimental field soil is also silty loam in texture with pH 6.5, low in organic carbon (0.38%), medium in phosphorus and potash (46 kg P_2O_5 ha^{-1} and 163 kg K_2O ha^{-1}, respectively). Sowing and transplanting of *tulaipanji* were done on 29^{th} July and 12^{th} September, 2006, respectively. Here, farmers use to grow *tulaipanji* without any fertilizer.

3. Results and Discussion

Experimental findings showed that HIT recorded 24.4 q ha^{-1} yield compared to 16.5 q ha^{-1} under conventional transplanting with 21 and 12 average effective tillers, respectively in the first experimental field (Table 1). In the second experiment, grain yield obtained 23.8 q ha^{-1} and 14.6 q ha^{-1} under HIT and conventional transplanting, respectively (Table 2). On an average, plant bears 18 effective tillers under HIT in comparison with 10 under conventional transplanting. Interestingly, 47.67% and 62.41% higher yields were obtained under new transplanting technique in the first and second experiment, respectively. Percentage yield increase under HIT for traditional management practice (second experiment) is higher as compared to recent farmers' practice (first experiment). These higher productivities were basically contributed by 70.5% and 89.7% higher number of effective tillers for each experiment respectively under HIT. Under recent farmers' practice, panicle length and number of filled grains $panicle^{-1}$ were 20.8 cm and 48, respectively under HIT, whereas they were 19.5 cm and 46, respectively under conventional transplanting. On the other hand, panicle length was measured as 21.0 cm under HIT and 18.8 cm under conventional transplanting and filled grain $panicle^{-1}$ was counted 59 under HIT as compared to 54 under conventional transplanting.

In new transplanting technique, higher number of seedlings (tillers) in a single hill with same spacing like conventional transplanting can be accommodated easily as the culms and leaves of *tulaipanji* are very thin (even much thinner than other local rice varieties). So, higher number of culms and leaves in a single hill did not have any negative effect on yield contributing characters studied. Another interesting observation of the HIT is that, about 58% and 65% effective tillers $hill^{-1}$, respectively have been contributed by the main tillers and 42% and 35% respectively, by side tillers in the first and second experiment. Whereas, in conventional transplanting about 41% and 52% respectively, have been contributed by main tillers and 59% and 48% respectively by side tillers in the first and second experiment. Due to better development, main tillers produced longer and well-developed panicle (and thereby, more number of grains $panicle^{-1}$ or filled grains $panicle^{-1}$) than side tillers. So, ultimately greater contribution by main tillers to total effective tillers $hill^{-1}$ also increased the total productivity under HIT technique.

It has been mentioned earlier that, stress conditions (low moisture and fertility level and late sowing) which are very specific traditional management practices for best quality *tulaipanji* production, are responsible for poor tiller formation and weak tiller development. So, the problem of the poor tiller formation and weak tiller development due to organic, low input based management practices followed in second experimental field, has been encountered in a better way by increasing number of seedlings $hill^{-1}$ (12-14 instead of 3-5 for conventional) under HIT technique.

4. Conclusion

Thus, the new transplanting technique termed as High Intensity Transplanting is an innovative approach for enhancing productivity of the local aromatic cultivar. The agro-technique increases yield, however, stress condition followed as the specific traditional management practices for production of best quality *tulaipanji* rice, can be maintained in the field. Interesting fact is that the technique does not depend on chemical resources to raise the production.

5. Further Research

This novel technique seems to be easily adoptable to local farmers. However, more experimental investigations are needed for proper validation of outcome obtained from the experimental results. Efficacy of the HIT technique may be evaluated in case of several other local aromatic quality rice cultivars which are poor yielding. Detailed quality analysis, including aroma content, should be conducted to check the effect of HIT technique on quality parameters. As the local cultivars are getting extinct mainly due to preference of introduced high yielding cultivars, government or financial institution should come forward to encourage further research that not only can enhance the productivity of *tulaipunji* cultivar but also socio-economic condition of the growers.

6. Acknowledgement

Authors are highly thankful to Mr. Pijush Kumar Chowdhury, Mr. Anil Biswas and Mr. Ghanenath Mahato for their kind co-operation during conducting the research work.

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Table 1: Result of the first experiment (recent farmers' practice)

Transplanting technique	Effective tiller hill^{-1}	Non-effective tiller hill^{-1}	Panicle length (cm)	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	Grains panicle^{-1}	Yield (q ha^{-1})
Conventional	12	2	19.5	46	11	57	16.5
High Intensity Transplanting	21	4	20.8	48	13	62	24.4

Table 2: Result of the first experiment (traditional management practice)

Transplanting technique	Effective tiller hill^{-1}	Non-effective tiller hill^{-1}	Panicle length (cm)	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	Grains panicle^{-1}	Yield (q ha^{-1})
Conventional	10	1	18.8	54	7	61	14.6
High Intensity Transplanting	18	2	21.0	59	8	66	23.8