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Assessment of Rice Varieties for Higher Productivity and Profitability in Lowland Condition under Mid Hill Ecosystem of Nagaland

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ABSTRACT

On farm testing on rice was conducted at farmers field during the Kharif season of 2016-17 and 2017-18 to assess the performance of rice variety suitable for the Longleng District by the Krishi Vigyan Kendra, Longleng, Nagaland. Result (mean 2 years) revealed that growth and yield parameters (plant height, tiller/hill, panicle, length, panicle weight) were recorded higher under MTU1010 than local check (Teiphek youh) The maximum grain yield was recorded 37.4 q/ha with MTU1010 than the local check (33.7 q/ha) and which was recorded 10.97 per cent than the local check. Similarly, production efficiency was recorded highest with MTU1010 (32 kg/ha/day) as compared to local check (26.1 kg/ha/day). With respect to economics, the maximum net returns and benefit: cost ratio (B: C ratio) were recorded with MTU1010 (Rs.22248/ha and 1.98) as compared to farmers variety. Economic efficiency was also noted higher with MTU1010 (Rs.190.29 /ha/day) than farmers variety (Rs.138.10 /ha/day). Energetics was also recorded higher with MTU1010 than the farmers variety. From the above result, It may be concluded that the farmers variety can be replaced with MTU1010 for better productivity, profitability for their adaptability to the local environment under Longleng District of Nagaland

1. Introduction

Rice is the second largest produce cereal in the world in 158.3 million hectare area with annual production of about 685.24 million metric tons (FAOSTAT 2011) and the staple food for over one third of the world's population, but more than 90% of rice is produced and consumed in Asia. Rice providing 50 -80 % of their daily calorie intake to the world population meal. (Khush, 2005; Amirjani, 2011). In India, rice occupies an area of 44 m ha with a production of ~ 112.91 mt with average productivity of ~ 2.57 t/ha (Agricultural statistics at a galance, 2018.). Demand for rice growing is increasing every year and it is estimated that in 2025 AD, its requirement would be 140 mt. To sustain the present food self sufficiency and to meet the future food requirement, India has to increase the rice productivity by 3% per annum (Thiyagarajan, 2007).

The crop is cultivated in an area of about 3.5 m ha in NER with an average productivity of 2.15 t/ha, which is below the National average (2.57 t/ha). Rice is staple food of Nagaland and cultivated in an area of ~21.2 thousand ha and producing 42.4 thousand tonnes with a productivity of ~ 2.0 t/ha. Longleng district is dominating by the tribals and livelihood of the people largely depends on agriculture production system. Rice is the main staple food and cultivated in an area of ~ 8.57 thousand ha with the production of 19.38 thousand tonnes and productivity ~2.26 t/ha (Anonymous, 2018). The tribal people of the district are not even able to meet their food requirement due to the lowest productivity of rice. The reason for such low productivity is the non-adoption of high yielding varieties. Therefore, the Krishi Vigyan Kendra Longleng took the initiative and conducted an On Farm Testing (OFT) during the *kharif* season of 2016-17 and 2017-18 on HYV

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(MTU1010) of rice with local rice variety (*Cv.* Teiphek youh) for achieving productivity and profitability of the poor tribal farmers of the Longleng District of Nagaland.

2. Materials and Methods

A field experiment was conducted at farmer's field of Krishi Vigyan Kendra, Longleng, ICAR- Research Complex for North Eastern Hill Region, Nagaland Centre Jharnapani, Medziphema during the two consecutive *kharif* seasons of 2016-17 and 2017-18. The experimental site was located between at 260 26' 0" N Latitude, 940 52' 0" E Longitude with an altitude of 1366 m above mean sea level. The soil of the experimental field was sandy loam and acidic in reaction (pH 5.3), high in organic carbon (0.95%), Medium in available N (308 kg/ha) and medium in available P (13.7 kg/ha) and K (258 kg/ha). Total annual rainfall varied between 1096 mm and 1742 mm during 2016-17 and 2017-2018 respectively. Maximum rainfall was received 348 mm in July month and average (2 years) rainfall was 1343 mm during (May-October) cropping period (Fig 1). The average (2 years) monthly mean maximum and minimum temperatures during the study period ranged from 28.22 to 32.93 ^{0}C and 20.13 to 24.48^{0}C, respectively. On farm testing was conducted to test the production potential of two rice varieties *viz.* MTU1010 and Teiphek youth (as check) under Longleng District of Nagaland with five replications. The duration of the MTU1010 and Teiphek youth were 115-125 days and 120-130 days respectively. Seeds of two varieties were sown in a nursery beds and after 25-30 days old seedlings were transplanted with three seedlings per hill at a spacing of 20 x 15 cm. The recommended doses of NPK (60:50:30 kg/ha) was applied for cultivation of rice. Entire doses of phosphorus and potassium were applied as basal and incorporated into the soil incorporated uniformly before the transplanting of rice in the form of DAP and MOP. Fertilizers N in the form of urea was applied in three equal splits i.e., 1/3rd as basal, 1/3rd as tillering and 1/3rd at panicle initiation stage. Two hand weeding was given at 20 and 45 days after transplanting (DAT). Neem oil @ 3ml per litre of water during the flowering stage for controlling the insect and no disease appeared during the cropping cycle. Five plants were selected from hill at randomly in each treatment to record the observation on growth and yield parameters. Data collected on plant height, tillers/plant, panicle length and panicle weight were recorded at crop maturity. Grain and straw yield were determined of each plot and adjusted to a standard moisture content of 0.14 g H O g-1 fresh weight. Moisture content of the grain of each plot was determined and test weight was converted to a standard 12% moisture content. Harvest index (HI) was computed by the formula given below:

$$\text{Harvest Index(HI)} = \frac{\text{Grain yield}}{\text{Biological (Grain + Straw) yield}} \text{ X } 100$$

In economics, cost of cultivation was taken into account for calculating economics of treatments as work out net return per ha and benefit-cost ratio. The gross returns were taken as total income from the produce of grain and straw yield based on prevailing price. Net return and benefit-cost ratio was calculated with the help of following formula:

Net Return (Rs/ha) = Gross return (Rs/ha) - cost of cultivation (Rs/ha)

$$\text{Benefit cost ratio:} \quad \frac{\text{Gross return (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Production efficiency and economic efficiency were calculated with the help of the formula (Kumar *et al.,* 2017)

$$\text{Production efficiency(kg/ha/day)} = \frac{\text{Grain yield(kg/ha)}}{\text{Total duration of the crop (in days)}} \text{ x } 100$$

$$\text{Economic efficiency(Rs/ha/day)} = \frac{\text{Net return(Rs/ha)}}{\text{Total duration of the crop (in days)}} \text{ x } 100$$

Energy input and output were calculated by converting various inputs used viz. labour, fertilizer and farmyard manure and output i.e. grain and straw into energy units (MJ) as indicated by (Devasenapathy *et al.*, 2009). Energy output from the product (grain) was calculated by multiplying the amount of production and its corresponding energy equivalent. Energy outputs from by-product (straw/leaves/ stalk) were estimated by multiplying to its corresponding energy equivalent.

Net energy return: It is the difference between the gross output energy produced and the total energy required to obtain it (input energy).

$$\text{Energy profitability(PE)} = \frac{\text{Net energy return(MJ/ha)}}{\text{Input energy (MJ/ha)}}$$

$$\text{Energy productivity(EP)} = \frac{\text{Crop economic yield(kg/ha)}}{\text{Energy input (MJ/ha)}}$$

$$\text{Energy use efficiency (EUE)} = \frac{\text{Energy output (MJ/ha)}}{\text{Energy input (MJ/ha)}}$$

$$\text{Specific Energy (SE)} = \frac{\text{Energy output (MJ/ha)}}{\text{Crop economic yield (kg/ha)}}$$

The data of growth and yield attributes, gross, net returns and energetic were statistically analysed year-wise according to standard procedures.

3. Results and Discussion

Growth and yield attributes

Mean data of two years were presented in the table 1 and result revealed that the maximum plant height was recorded 116 cm in Telphek Youh (as farmers variety) than the improved rice variety of MTU 1010 (105.7 cm). Whereas, maximum tillers no. per hill was recorded 7.3 with MTU 1010 than Teiphek youh (5.2 nos). Yield attributes such as panicle weight and panicle length were recorded 4.1 g, 3.4 g and 22.6 cm, 21.4 cm in MTU1010 and Telphek Youh respectively. Percentage increase in panicle length and panicle weight were 20.58 and 5.60 with MTU1010 than farmers variety respectively. Higher yield attributes was recorded with MTU1010, might be due to these variety having some physiological ability to produce higher yield attributes in the particular environment. Variations in growth and yield attributes of different rice varieties might be due to that the different rice varieties having different genetic characters (Kumar *et al.,* 2016). Different rice varieties have a difference in growth and yield attributes (Kikon *et al,.* 2018 and Singh *et al.,* 2017).

Yield and Harvest Index

Maximum grain and straw yield were recorded 37.4 q/ha and 51.34 q/ha respectively in MTU1010 as compared to farmers variety (33.7 q/ha and 50.89 q/ha respectively). Grain yield of MTU 1010 was recorded 10.97 percent higher than the farmers variety. The highest grain yield was recorded in these genotypes attributed to the maximum filled grain percentage panicle weight and panicle length (table 1). Variation in yield might be due to the genetic yield potential of different rice cultivars (Kumar *et al.* 2016). Higher production efficiency was also recorded in MTU1010 (32.00 kg/ha/day) as compared to farmers variety. This might be due to MTU 1010 variety produced more yield in less duration than Telphek Youh. Similarly, the harvest index was also recorded higher in MTU1010 (42.17%) than farmers variety (39.84 %). This might be due to the higher grain yield produced by MTU 1010 than farmers variety. The same results were also reported by Singh *et al.,* (2017) and Sharma & Bhutia (2018).

Economics

Maximum net return (Rs.22248/ha), and benefit cost ratio (1.98) were recorded with MTU1010 than Telphek Youh (Rs.17808/ha, 1.79). Econmic efficiency was recorded 190.29 Rs/ha/day and 138.10 Rs/ha/day in MTU1010 and Telphek Youh respectively (table 2). This might be due to MTU1010 variety recorded more yield than farmers variety.

Energetic

Energy analysis is new tools for judging treatment efficiency and the respective treatment is considered more efficient when it produces higher output energy and requires less input energy. The total input energy was recorded 7407.68 MJ/ha in both the variety. Maximum output energy was recorded

119153 MJ/ha, which was 5.30 % higher than Telphek Youh rice variety Higher net energy, energy use efficiency, energy profitability and energy productivity were recorded 111745.3 MJ/ha, 16.08 %, 15.08 and 0.51 kg/MJ with MTU1010 than Telphek Youh rice variety(Table 3). Whereas, specific energy was higher in MTU1010 (33.58 MJ/kg) than Telphek Youh (31.86 MJ/kg). This indicated that maximum quantum of energy was required to produce one unit of output in Telphek Youh rice variety while the highest amount of product produced per unit of energy invested was under MTU1010 rice variety. Variations in energy input and outputs are responsible for differences in EUE, EI and productivity (Yadav *et al.,* 2017 and Kumar *et al.*, 2017).

4. Conclusions

From the above result, It may be concluded that the farmers variety can be replaced with MTU1010 for better productivity and profitability. This variety was best suited for the climatic condition in Longleng District of Nagaland. Farmers interested to grow MTU1010 variety due to their good taste.

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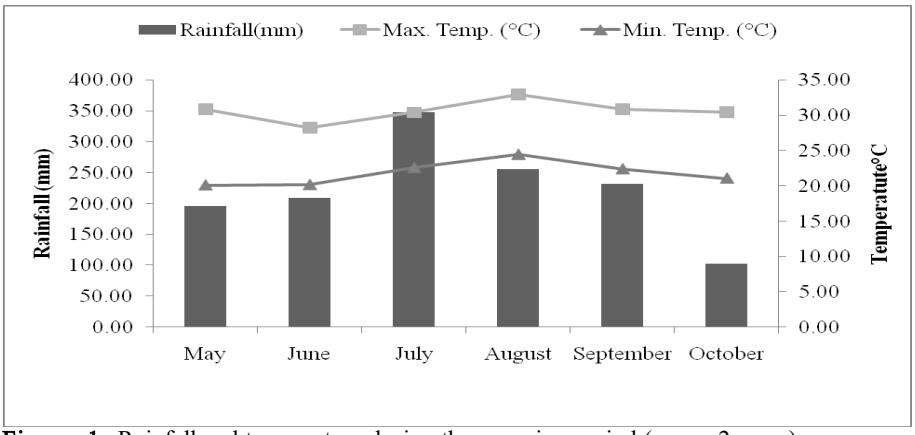

Figure 1. Rainfall and temperature during the cropping period (mean 2 years)

Table 1. Growth, yield and their attributes of rice varieties (mean 2 years)

Varieties	Plant height(cm)	Tiller/hill (Nos.)	Panicle wt. (g)	Panicle length(cm)	Seed yield (q/ha)	Straw yield (q/ha)	HI(%)
MTU1010	105.7 ± 3.13	7.3 ± 1.34	4.1 ± 0.34	22.6 ± 0.78	37.4 ± 1.10	51.34 ± 2.46	42.17 ± 1.38
Teiphek youh	116 ± 3.23	5.2 ± 1.4	3.4 ± 0.30	21.4 ± 0.73	33.7 ± 1.57	50.89 ± 2.20	39.84 ± 1.46

Table 2. Effect of rice varieties on economics and efficiency

Variety	Net return (Rs/ha)	B:C ratio	Production efficiency (kg/ha/day)	Economic efficiency (Rs/ha/day)
MTU1010	22248 ± 1187	1.98	32.0 ± 1.1	190.29 ± 11.7
Teiphek youh	17808 ± 1354	1.79	26.1 ± 0.7	138.1 ± 10.8

Table 3. Effect of energetic in different lowland rice variety

Varieties	Energy input(MJ/ha)	Energy output (MJ/ha)	Net energy (MJ/ha)	Energy use efficiency (%)	Energy profitability	Energy productivity (kg/MJ)	Specific Energy (MJ/kg)
MTU010	7407.68	119153.0	111745.3	16.08	15.08	0.51	31.86
Teiphek youh	7407.68	113151.5	105743.8	15.27	14.27	0.45	33.58

OFT on rice visited by Sr. Scientist and Head and general view of the rice field