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Performance of selected traditional rice varieties under Namsai conditions of eastern Himalayas

ANCHALI YAO¹, AVINASH SHARMA^{1,*}, CHOWLANI MANPOONG¹, V. S. DEVADAS²
AND SHEELAWATI MONLAI¹

¹Faculty of Agricultural Sciences

Arunachal University of Studies, Namsai-792103, Arunachal Pradesh, India

^{*}(e-mail : avinashcau@gmail.com)

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ABSTRACT

The traditional rice varieties were evaluated for furnishing complimentary and climate adopted high yield crop to the district farmer. The selected rice varieties maintain food production and security in the district. An experiment was conducted at the Agricultural Research Farm of the Arunachal University of Studies to assess the performance of selected traditional varieties of rice. Twelve traditional varieties of rice from Arunachal Pradesh as well as from other states (viz., Anjali, Hauska rice, Namsai Local, Gandhakasala 1, Khamti Lahi, Sali, Ambing, Taker, Gandhakasala, Bora, Bihari Dhan and Jeerakasala) were evaluated in a randomized block design with three replications during *Kharif* season of 2020. The varieties differed significantly for all the growth and yield parameters studied. The growth parameter of Tillers per hill (31.3) and plant height (97.13 cms) were observed in the Khamti Lahi, whereas the number of tillers (11.83) and the plant height (62.97 cms) were recorded by Ambing and Namsai Local respectively. The crop duration was seen in Bora (90 days), followed by Ambing and Namsai Local (100 days), and in Jeerakasala (138 days), Gandhakasala 1, Sali and Gandhakasala (137 days). The yield was reported in Khamti Lahi (1.81 kg/ 6 sq m and 130.67 days duration) followed by Sali (1.74 kg yield and 100.67 days duration) and Ambing (0.58 kg yield and 103.33 days duration). The yield of short duration variety like Bora (90 days duration and yield of 1.10 kg/ plot), and Taker (103 days duration and 1.23 kg yield) were reported to introduce double production for overcoming farmer's crop problem. The correlation analysis showed that plant height, duration of vegetative phase, productive tillers and grains per panicle are the major factors contributing to yield, and these characters are important in a selection programme. The investigation also suggests further studies on utilization of scented or specialty rice varieties and possibility of genetic improvement of traditional varieties to enhance their productivity.

Key words : Correlation, evaluation, traditional rice varieties, yield

INTRODUCTION

Rice (*Oryza sativa* L., 2n=24) is semi aquatic phanerogamic plant, belongs to *Poaceae* family and staple food of more than half of the world's population, especially in south-east Asia. In the world, the total food grains production of 2281 mt was estimated in 2021 crop year. The rice production of 519.3 million tons was recorded in the world in 2021 crop year (IGC, 2022; FAO, 2022). The total food grains production of 316.06 million tonnes was reported in that 127.93 million tonnes rice

production was recorded in India in 2021 crop season (PIB, 2022). The major rice producing countries are China, India, Indonesia, Vietnam, Thailand, Burma, Philippines, Japan, Pakistan, Brazil, USA, Nigeria, Egypt, South Korea and European Union in the World. In India, the major rice growing states are Andhra Pradesh, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Pondicherry, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal (Paddy Outlook, 2021). The agricultural industry and agriculture based

²Vanavarayar Institute of Agriculture, Pollachi-642103, Tamil Nadu, India.

industry prepares flaked rice, fermented sake, bran oil, bran, bran wax and husk. The Bran applies in the textile industry & leather industry. The Bran wax is extracted from the bran oil extract which is used in the chocolate and lipstick industry. The milled husk is used as fuel and brick making. The harvested Straw uses in manufacturing strawboards, hats, ropes & mats (Akhilesh *et al.*, 2014).

The northeastern farmers such as Manipur, Meghalaya, Arunachal Pradesh, Nagaland, Mizoram, Tripura and Sikkim are cultivated and managed the rice crop production for maintaining food security, self reliant and income of the state. The rice is the chief food crop in the Namsai agro-climatic ecosystem. The farmers prefer and continue to grow traditional variety but its productivity is very low in the ecosystem. The farmer cultivates secondary introduced local varieties in the district for complimentary crop, crop productivity and income progress. The introduced local variety has distinct characteristics like growth duration, yield, grain quality, nutritive value and cooking quality. The introduction of the local variety in the new district compensates crop loss, improves the income, thrives standard of living and per capita income of the farmer. It extends the capacity utilization & seed price stability in the seed industry and state economy.

The growth parameters, grain quality and yield were evaluated in the four Boro rice varieties (Bikash *et al.*, 2013). The performance of local rice cultivars was investigated with the interference of growth parameters like plant height, Number of filled grains per panicles, 1000 grain weight and grain yield, (Nahiba *et al.*, 2013). The variable of yield was obtained in the local rice varieties after the completion reproduction growth phase (Ram *et al.*, 2014; Sangma *et al.*, 2022). The twelve rice varieties were observed for grain qualities like amylose content, protein content, length, width, thickness, hardness, husk content and correlation co-efficient after harvesting management (Joshi *et al.*, 2014). The growth parameter, yield and grain quality in the rice varieties were investigated with comparative analysis in hybrid rice varieties and commercial rice varieties (Awal *et al.*, 2007; Kaur *et al.*, 2022). The phenotypic characters like plant height, days of maturity, panicle length, number of tillers per hill,

numbers of tillers per panicle and days of flowering, days to maturity, thousand seed weight and grain yield were evaluated in the rice varieties (Sushan *et al.*, 2017). The growth parameter, growth stages, grain quality and yield were investigated in Mallige idli rice, Gandasala rice and Basmati rice (Megha *et al.*, 2019). The performance of six rice genotypes were evaluated with plant growth characters, 1000 grain weight, grain yield, days to maturity and yield (Balqees *et al.*, 2019).

Under these circumstances, the present study was initiated to evaluate the performance of local rice varieties under Namsai conditions and to select the promising types suited for commercial cultivation. The objectives of this investigation were (1) to evaluate morphological growth and yield parameters in local rice varieties and (2) to evaluate correlation inter-relationships between growth and yield parameters in local rice varieties.

MATERIALS AND METHODS

The studies were conducted at the Agricultural Research Farm of Arunachal University of Studies, Namsai during *Kharif* season of 2020 crop year. The land type of the experimental field was typical rice growing medium, high of clay loam in texture with pH 5.63 and 88.2% moisture availability in the soil. The experimental site was affected by high temperature (maximum 32.30 °C), heavy rainfall (maximum 2309.1 mm) at an altitude of 131 m above sea level and high humidity (maximum 87.19 %) during the study period. The area falls under the Sub-Humid Tropical climate. The geographical position is 27°30'-28°45'N latitude and 95°45'-96°45' longitudes. The area falls under the Humid Sub-tropical climate.

Twelve traditional varieties of rice from Arunachal Pradesh as well as from other states including scented varieties from Wayanad, Kerala (Anjali, Hauska Rice, Namsai Local (Khaowtam), Gandhakasala 1, Khamti Lahi, Sali, Ambing, Taker, Gandhakasala, Bora, Bihari Dhan and Jeerakasala) were evaluated in a randomized block design with three replications. The plot size was 3 m x 2 m, and the crop was grown under traditional method without using any fertilizers. 30 days old nursery seedlings were transplanted in the

experimental field on 23 July 2020. Three hand weeding were done to check weed infestation in the experimental field at 20 Days after transplanting, 38 Days after transplanting and 50 Days after transplanting. The growth parameters plant height at maturity (cm), number of productive tillers, number of grains per panicle length of panicles (cm), 1000 grain weight (gm), number of days for panicle emergence (days), crop duration (days), length/breadth ratio of grains, yield/plot (kg/m²) and correlations coefficient were determined in the black rice varieties. The plant height was measured with centimeter scale, grain size was computed with Vernier scale and 1000 gm grain weight was calculated with weighing balance. Bora rice from Assam was harvested on 21th October, 2020; Ambing and Local rice Namsai was harvested on 31 October, 2020; Anjali was harvested on 6th November, 2020; Hauska rice was harvested on 1st November, 2020; Gandakasala 1 was harvested on 27th November, 2020; Jeerakasala was harvested on 28th November, 2020; Taker was harvested on 23rd October 2020; Gandakasala was harvested on 26th November 2020; Bihari Dhan was harvested on 7th Nvember 2020; Khamti Lahi was harvested on 20th November 2020; and last one is Sali was harvested on 26th November 2020. The data of the observations were collected and calculated with 5% CD value from ICAR-Wasp statistical software.

RESULTS AND DISCUSSION

Performance evaluation of the

Table 1. Mean growth and yield parameters of the 12 paddy varieties.

Local Variety	Plant height (cm)	Number of tillers/	Days for panicle emergence	Crop duration (days)	Length of panicle (cm)	No. of grains/ panicle	Length of grain (mm)	Breath of grain (mm)	1000- grains weight (g)	Yield of grains (kg/ 6 sq m)
Anjali	78.2	25.53	59.00	116.33	31.53	201.00	6.07	4.00	24.80	1.12
Hauska rice	79.5	21.28	59.00	112.67	28.53	303.67	8.00	4.00	23.44	1.55
Namsai Local	62.9	20.20	57.00	100.00	22.77	193.33	4.80	3.40	22.44	1.03
Gandhakasala I	85.3	18.33	98.00	137.67	40.20	286.00	5.33	2.80	15.90	1.07
Khamti Lahi	97.1	31.13	99.00	130.67	27.30	349.33	8.40	4.00	24.75	1.81
Sali	79.8	28.21	93.00	100.67	26.40	287.00	7.60	5.00	26.76	1.74
Ambing	72.7	11.83	58.67	103.33	23.65	242.33	7.43	5.00	26.33	0.58
Taker	78.4	21.95	55.00	136.67	26.30	222.00	9.93	4.00	26.50	1.23
Gandhaka sala	85.2	20.33	99.00	130.00	43.30	341.67	4.97	3.00	12.84	1.13
Bora	81.6	26.05	49.00	117.00	28.31	256.67	8.80	4.17	28.80	1.10
Bihari dhan	77.7	21.44	59.00	138.00	22.80	174.00	6.37	3.97	21.55	1.10
Jeerakasala	80.0	21.43	92.00	113.20	32.80	266.00	7.60	3.70	18.94	0.93
Se.M. (±)	6.5	1.01	0.19	1.09	1.41	0.08	0.06	7.87	0.08	0.06
SE.d.	0.36	1.43	0.27	1.54	2.00	0.11	0.08	11.14	0.12	0.09
C.D. (p= 0.05)	2.96	1.06	0.56	1.60	1.39	23.10	0.10	0.07	0.18	0.25
CV (%)	2.19	2.81	0.46	1.09	2.79	5.24	0.85	1.13	0.47	12.21

varieties and correlation of growth and yield parameters studies were examined and the results are presented below.

Performance of Local Rice Varieties

The average values of growth and yield parameters of the 12 varieties recorded are furnished in Table 1 and Fig. 1. There were significant variations between varieties among all the characters studied. The plant height of Khamti Lahi (97.1 cm) followed by Jeerakasala and Gandhakasala (85 cm each) and Namsai Local (62.9 cm) were obtained in the local rice variety. The plant height is controlled primarily by the genetic makeup of the plant and nutrients available are the secondary factors that affect plant height. Similar results have been reported by Singh *et al.* (2013b).

The local rice varieties showed significant differences in number of productive tillers also. The number of productive tillers were found in Khamti Lahi (31.13), followed by Sali (28.21) and Ambing (11.83). This shows the tillering capacity or nature of the varieties and varietal variation due to difference in their genetic makeup. Similar results were also reported by Slameto and Hendra (2021) who observed varietal variations in the number of tillers (Fig. 1).

In the current study it was observed that the variety Bora rice took minimum (49) days for panicle emergence, whereas varieties Khamti Lahi and Gandhakasala took maximum (99.00) days each for panicle

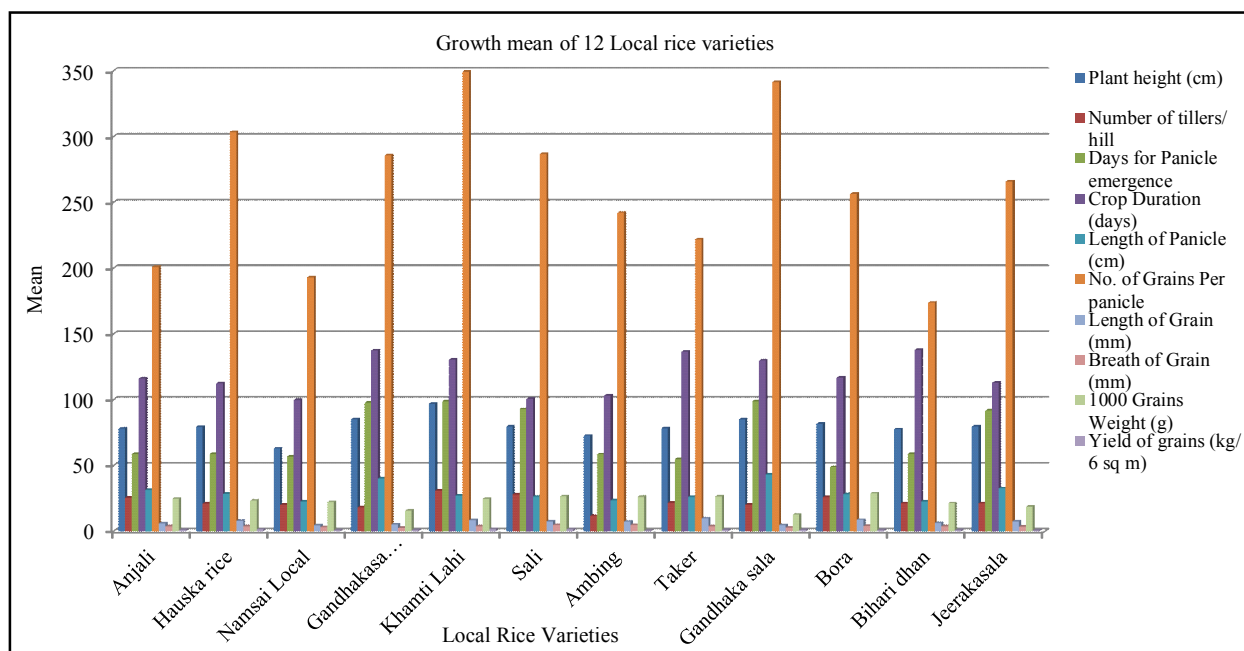


Fig. 1. Graphical abstract of morphological growth observations in local rice varieties.

emergence. Data also revealed that the variety Namsai Local Sali and Abing were harvested in 100, 100 and 103 days crop duration, respectively. Varieties Bihari Dhan (138 days) and Gandhakasala-I was harvested in 136.67 days crop duration, while Namsai Local and Sali were obtained 100 days of crop maturation and Abing was observed 103 days of crop maturation. Similar variations were reported among rice variety by Daba *et al.* (2015).

Results of yield and yield contributing parameters like, number of grains per panicle, length of panicle, average length of grains, 1000 grain weight varied significantly among the varieties. The data revealed that the panicle length was recorded in varieties Gandhakasala (43.30 cm), Gandhakasala-1 (40.20 cm) followed by Namsai Local (22.77 cm) and Bihari Dhan (22.80 cm). About more than 60% variation in yield could be explained by the variations in panicle length as reported by Touhid *et al.* (2015). The data revealed that average length of grain was recorded in variety Taker (9.93 mm) followed by Bora (8.8 mm), Namsai Local (4.80 mm) and Gandhakasala (4.97 mm). Rice is primarily classified according to its grain size (Diako *et al.*, 2011) and in certain locations consumers prefer long grains. In case of 1000 grain weight, Bora (28.80 g), Anjali (24.80 g) followed by Khamti Lahi (24.75 g), Hauska rice (23.44 g), Namsai Local (22.44 g) and Gandhakasala (12.84 g)

were obtained after Post Harvest Handling in the field. Higher grain weight influences the higher yield. The results also revealed that the variety Khamti Lahi (1.81) produced yield (1.81 kg/ 6 sq m) per plot and was found to be significantly superior other varieties. This was followed by Sali (1.74 kg). The yield was obtained from Abing (0.58 kg) and Jeerakasala (0.93 kg). The high yield attains in maximum plant height, tillers, crop duration and grains per panicle. Maximum variability in terms of co-efficient of variation (CV) was observed with respect to yield (12.21%) and number of grains per panicle (5.24 %). Similar variability in morphological characters, yield and yield contributing components were significantly different among rice varieties were reported by Idris *et al.* (2012), Iqbal *et al.* (2018) and Tiwari *et al.* (2019) (Fig. 2).

Among the 12 varieties evaluated, the growth and yield parameters Khamti Lahi, Sali, and Hauska were found promising varieties for yield, but had a higher duration and tendency for lodging due to plant height. The variety Bora was found to have shorter plant stature (49 cm), duration (117 days) and had a satisfactory yield (1.10 kg).

Correlation Studies Between Growth and Yield Parameters in Local Rice Varieties

Correlation coefficients between 10

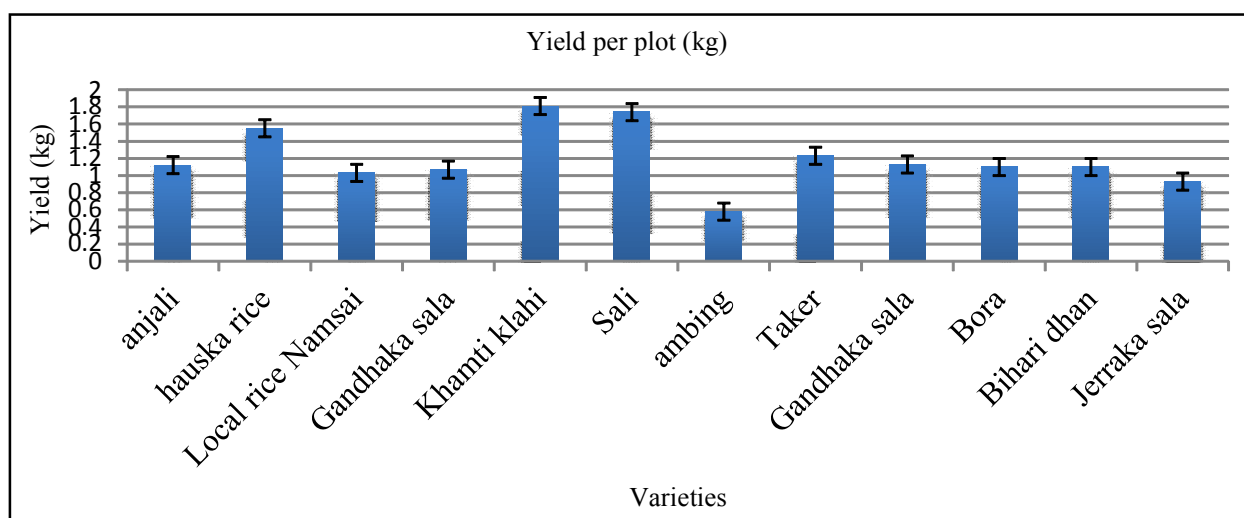


Fig. 2. Yield observation in the local rice varieties.

Table 2. Correlation coefficients between growth and yield parameters.

	GPP	LP	LG	BG	LBR	GW	YPP	PHVP	PTVP	DPE
GPP	1									
LP	0.33	1								
LG	0.08	-0.19	1							
BG	-0.16	-0.45	0.64*	1						
LBR	0.24	0.36	0.65*	-0.14	1					
GW	-0.28	-0.35	0.72*	0.84**	0.09	1				
YPP	0.50	0.03	0.35	0.12	0.22	0.24	1			
PHVP	0.74*	0.44	0.23	-0.15	0.44	-0.17	0.55	1		
PTVP	0.27	0.03	0.36	0.12	0.25	0.35	0.81**	0.53	1	
DPE	0.72*	0.45	-0.31	-0.34	-0.01	-0.54	0.35	0.63*	0.24	1

Pearson Critical value: 0.63 (P=0.05); 0.77 (P = 0.01); GPP -No. of grains/panicle; LP - Length of panicle; LG - Length of grains; BG: Breadth of grains; LBR - Length/ breadth ratio; GW - 1000 grains weight; YPP - Yield per plot; PHVP- Plant height at vegetative phase, PTVP - No. of productive tillers at vegetative phase, DPE: Days to panicle emergence.

growth and yield parameters studied are furnished in Table 2. It was observed that number of grains per panicle was positively and significantly correlated with plant height at vegetative phase (0.74) and days to panicle emergence (0.72) *i.e.*, duration of vegetative phase. 1000 grain weight was significantly and positively correlated with length (0.72) and breadth (0.84) of grains. Grain length had significant positive influence on grain breadth (0.64), L/B ratio (0.65) and 1000 grain weight (0.72). Yield per plot had high positive and significant correlation with number of productive tillers at vegetative phase (0.81). Days to panicle emergence was significantly and positively correlated with plant height at vegetative phase (0.63) and number of grains per panicle (0.72). The correlation analysis showed that plant height, duration of vegetative phase, productive tillers and grains

per panicle are the major factors contributing to yield, and these characters are important in a selection programme. Idris *et al.* (2012), Iqbal *et al.* (2018), and Tiwari *et al.* (2019) also reported positive significant correlation of grains yield with days to 50% flowering, number of panicles per plant and number of filled grains per panicle. The same characters showed positive and highly significant correlation with grain yield. Similar results were also reported by Shanthi and Singh (2001), Singh *et al.* (2013a) and Kumar *et al.* (2016).

CONCLUSION

The growth and yield parameters of the twelve varieties suggested that Khamti Lahi followed by Sali varieties are most promising, but they had a longer duration and tendency for lodging due to increased plant height. But

Bora and Taker rice varieties were found to have shorter duration. Bora had a satisfactory yield as compared to Taker. Bora, Jeerakasala and Gandhakasala are scented rice varieties. Taker, also called as red rice is sticky in nature and it has a great demand among the local people for the preparation of traditional local wine from it. Hence variety Khamti Lahi is recommendable for commercial cultivation because of its finest grain quality and yield particularly under Namsai conditions. The studies also throw light for possibility of utilizing short duration varieties like Bora and Taker) for double cropping. The utilization of scented, stickiness or specialties of rice varieties enhance the productivity and revenue of the farmer.

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