Evaluation of Upland Rice Varieties in Western Terai of Nepal

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Abstract: Sixteen rice varieties were collected from Banke, Bardiya, Kailali and Kapilvastu districts to select the superior varieties for upland rain-fed condition. These varieties were tested in RCBD with three replications in the years 2018 and 2019. The parameters compared were heading and maturity days from sowing, plant height, and number of tillers per square meter, grain and straw yield per hectare. Varieties were significantly different for all the traits studied. The variety earliest to head (84 days) and maturity (115 days) was Hardinath-1. Shortest plant height (99.8cm) was observed in Parssana and the longest (157.0 cm) in Sugapankhi. Maximum number of tillers/m^2 (319) was recorded in PH-6. Among the tested genotypes, Sampurna produced significantly higher grain yield (4628 kg/ha) followed by Sama (4320 kg/ha) and Prasanna (4208 kg/ha), while highest straw yield (9859 kg/ha) was obtained from Sugapankhi. The superior varieties will be used as reference variety to develop new varieties.

Keywords: Upland rice, Western terai, Rice genotype, Yield, Khajura

Introduction

Rice is major cereal crop of Nepal, which is also one of the major staple foods globally contributing more than 20% of calorie intake (Abdullah et al., 2015; Sharma et al., 2007). In Nepal rice is grown up to altitude of 3050m above sea level which is one of the highest regions of rice cultivation in the world. In 2021, average productivity of rice was 3.47 tons per hectare (t/ha) (MoALD, 2022). Among the total rice production two third of production is produced in southern plain of the country (Tripathi et al., 2012). Upland rice covers at least 9% of total rice area in Nepal (Sapkota, 2017), which is mainly grown in rain-fed conditions.

The demand for early maturing, rain-fed varieties that are suitable for upland conditions is increasing day by day due to farmers' increased interest in growing vegetables and other winter crops (Sah et al., 2013). The western terai has a lot of potential for rice production, but Basyal et al. (2019) point out that some of the main obstacles are a lack of better varieties, a shortage of chemical fertilizers, a lack of appropriate farm equipment, and a reliance on monsoon rains for cultivation. There are not many upland rice varieties that are appropriate for different areas, so research is necessary to choose one. If farmers choose to grow other crops instead of upland rice, it could jeopardize the diversity of upland rice in the agro-ecosystem (Tiwari et al., 2018).

In order to ensure a respectable crop yield in rain-fed environments in Nepal's western terai, it is necessary to identify suitable early maturing rain-fed rice varieties with higher yield potential and resistance to insect pests and diseases. A good way to help impoverished marginal farmers would be to cultivate an appropriate upland rice variety under good management practices (Pokhrel et

al., 2019). The current study's goal is to choose an upland rice variety that is suitable for western terai. The information gathered from this study may be helpful for future breeding initiatives aimed at developing new cultivars that are suitable for western terai's uplands.

Material and Methods

Experimental Setup

Field experiment was conducted which comprising sixteen upland rice varieties collected from Banke, Bardiya, Kailali and Kapilvastu districts at Directorate of Agriculture Reasearch (DoAR), Khajura, Banke during the main season of 2018 and 2019. The experiment was replicated three times in the Randomized Complete Block Design (RCBD). The rice varieties used for investigation were Hardinath-1, Anandi, Makarkaddu, Sarju-52, Champion, Sukkha dhhan-2, Sugapankhi, Sukkha dhhan-1, Ghaukumari, Sampurna, Sama, Ghaiya, Parssana, 6451, Sukkha dhhan-3 and PH-6. Transplanting was done by 26 days old seedlings maintaining spacing of 20cm x 20cm. The fertilizer was applied with recommended dose 100:30:30 N: P_2O_5: K_2O kg ha^{-1}. Full dose of phosphorus, potash and half dose of nitrogen were applied as basal dose after final land preparation and remaining dose of nitrogen was applied in two equal splits (Active tillering and panicle initiation stage). All the other intercultural operations and necessary package of practice were conducted as recommended by National Rice Reserach Program (NRRP), Hardinath, Dhanusha.

Data Recording and Analysis

The data such as days to heading, days to maturity, plant height (cm), panicle length (cm), tiller/m^2, straw yield (kg/ha) and grain yield (kg/ha) were recorded from each plot. The data recorded on various parameters were subjected to the analysis of variance (ANOVA) method to find out the variance between all tested genotypes and mean comparisons among treatment means were estimated by the least significant difference (LSD) test at 5% levels of significance. Statistical analysis software GENSTAT was applied for computing the recorded data.

Results and Discussion

During 2018, result revealed that all the observed parameters except for tillers per squared meters (tiller/m^2) were found to significantly vary among the tested varieties. The early maturity (115 days) was observed in Champion and Hardinath-1 followed by 116 days in PH-6, Ghaiya, Ghaukumari and Sukhkhadhan-2. The highest yield of 4732 kg/ha was observed in Sukhkhadhan-3 followed by Sampurna (4738 kg/ha) and Sama (4714 kg/ha). The highest straw yield (13125 kg/ha) was recorded in Sugapankhi followed by 10903 kg/ha in Sukhkhadhan-1 (Table 1).

Table 1: Yield and yield attributing parameter of rice varieties in upland conditions at DoAR, Khajura, 2018

S.N.	Varieties	Days to heading	Days to maturity	Plant height (cm)	Panicle length (cm)	Tiller /m2	Straw yield (kg/ha)	Grain yield (kg/ha)
1	Hardinath-1	86	115	92.1	20.3	292	8055	3619
2	Anandi	99	126	118.5	22.2	214	7616	3595
3	Makarkaddu	103	127	98.6	21.5	328	7662	4262
4	Sarju-52	103	132	97.5	23.0	261	7801	4119
5	Champion	85	115	95.1	21.7	305	7500	3833
6	Sukhkhadhan-2	90	116	103.8	22.3	266	8009	4619
7	Sugapankhi	115	142	140.0	23.7	211	13125	1976
8	Sukhkhadhan-1	103	130	105.0	21.8	308	10903	2952
9	Ghaukumari	91	116	109.6	20.1	185	7593	2548

10	Sampurna	112	122	93.2	22.7	338	7662	4738
11	Sama	111	137	99.6	21.6	296	7731	4714
12	Ghaiya	87	116	98.9	21.7	285	8032	3881
13	Parssana	115	137	90.5	23.4	258	8264	4119
14	6451	103	122	102.4	21.9	336	9861	3071
15	Sukhkhadhan-3	88	117	102.4	23.5	292	7523	4762
16	PH-6	91	116	114.9	20.7	378	9259	2143
	GM	99	124	103.9	22.0	291	8537	3685
	F-test	**	**	**	**	ns	**	**
	LSD(0.05)	1.465	3.277	8.211	1.771	96.55	1848.3	565.1
	CV (%)	0.9	1.6	4.7	4.8	19.9	13.0	9.2

Note: cm- centimeters, Tiller/m^2-Tillers per squared meter , Kg/ha- kilograms per hectare, **- Highly significant, ns- non-significant

During 2019, result revealed that all the observations for days to heading, days to maturity and plant height were found to be significantly vary among the tested varieties, where as other parameters did not vary significantly. The early maturity was observed in Hardinath-1 (116 days), Anadi (121 days), Champion (121 days) and Sukhkhadhan-2 (122 days) respectively. However, the highest grain yield was reported in Sampurna (4518 kg/ha), whereas the highest straw yield (9778 kg/ha) was recorded in Sama (Table 2).

Table 2: Yield and yield attributing parameter of rice varieties in upland conditions at DoAR, Khajura, 2019

S.N.	Varieties	Days to heading	Days to maturity	Plant height (cm)	Panicle length (cm)	Tiller /m2	Straw yield (kg/ha)	Grain yield (kg/ha)
1	Hardinath-1	81	116	114.5	23.7	343	6426	3756
2	Anandi	83	121	135.4	25.9	261	6944	4167
3	Makarkaddu	82	130	108.2	24.2	284	6056	4037
4	Sarju-52	92	133	105.5	23.7	268	6000	3537
5	Champion	88	121	121.1	24.7	224	6663	3796
6	Sukkha dhhan-2	85	122	110.4	24.4	243	5096	3426
7	Sugapankhi	98	146	173.6	25.1	395	6592	3408
8	Sukkha dhhan-1	84	124	119.5	24.0	276	6630	3741
9	Ghaukumari	102	144	119.7	23.0	260	7037	3148
10	Sampurna	94	145	123.8	24.6	299	6963	4518
11	Sama	111	148	121.4	23.0	288	9778	3926
12	Ghaiya	86	130	104.0	24.8	298	6370	3815
13	Parssana	91	141	109.2	24.8	323	7740	4296
14	6451	84	131	114.6	25.5	257	7278	3463
15	Sukkha dhhan-3	89	125	112.8	24.1	265	7611	3222
16	PH-6	84	128	111.8	22.1	261	8834	3389
	GM	89	131	119.1	24.2	284	7001	3728
	F-test	**	**	**	ns	ns	ns	ns
	LSD(0.05)	7.476	2.965	21.71	-	-	-	-
	CV (%)	5.0	1.3	10.9	7.6	18.4	23.3	16.5

Note: cm- centimeters, Tiller/m^2-Tillers per squared meter , Kg/ha- kilograms per hectare, **- Highly significant, ns- non-significant

The two years data were combined and analyzed for the observations such as days to heading, days to maturity, plant height, tiller per meter squared and grain yield varied significantly among the varieties while non significant difference was observed for panicle length and straw yield (Table 3). The variety earliest to head (84 days) and maturity (115 days) was Hardinath-1. Shortest plant height (99.8cm) was observed in Parssana and the longest (157.0 cm) in Sugapankhi. Maximum number of tillers/m^2 (319) was recorded in PH-6. Among the tested genotypes, Sampurna produced significantly higher grain yield (4628 kg/ha) followed by Sama (4320 kg/ha) and Prasanna (4208 kg/ha), while highest straw yield (9859 kg/ha) was obtained from Sugapankhi. Puri et al. (2021) reported that Hardinath-1 as suitable variety for spring season. It may be due to its early maturity and encountered low infestation of stem borer with

no incidence of false smut. Different genotypes respond to environmental variation differently, which may be because most genotype traits are influenced by the environment and how they interact with it (Jadhav et al., 2019).

Table 3: Yield and yield attributing parameter of rice varieties in upland conditions at DoAR, Khajura (2018 and 2019 combined)

S.N.	Varieties	Days to heading	Days to maturity	Plant height (cm)	Panicle length (cm)	Tiller /m2	Straw yield (kg/ha)	Grain yield (kg/ha)
1	Hardinath-1	84	115	103.7	22.0	318	7241	3689
2	Anandi	91	123	127.0	24.0	237	7280	3881
3	Makarkaddu	92	128	103.4	22.9	306	6859	4150
4	Sarju-52	98	132	101.5	23.3	264	6900	3828
5	Champion	86	118	108.1	27.3	264	7083	3815
6	Sukkha dhhan-2	87	119	107.1	23.4	255	6551	4023
7	Sugapankhi	107	144	157.0	24.4	303	9859	2692
8	Sukkha dhhan-1	94	127	112.3	22.9	292	8766	3347
9	Ghaukumari	96	130	114.7	21.5	272	7315	2848
10	Sampurna	103	134	108.5	23.7	318	7313	4628
11	Sama	111	143	110.5	22.3	292	8755	4320
12	Ghaiya	86	123	101.4	23.2	291	7201	3848
13	Parssana	103	139	99.8	24.1	290	8002	4208
14	6451	93	127	108.5	23.7	297	8570	3267
15	Sukkha dhhan-3	89	121	107.6	23.8	278	7567	3992
16	PH-6	88	122	113.4	21.4	319	9047	2766
	GM	94	128	111.5	23.4	287	7769	3706
	F-test	**	**	**	ns	**	ns	**
	LSD(0.05)	7.280	5.988	11.85	-	72.16	-	723.8
	CV (%)	6.7	4.1	9.2	13.5	21.8	21.1	17.0

Note: cm- centimeters, Tiller/m^2-Tillers per squared meter , Kg/ha- kilograms per hectare, **- Highly significant, ns- non-significant

Conclusions

Western terai of Nepal is suitable for rice cultivation but accounts huge area of upland condition where upland rice could be option to higher rice production. This study was conducted with sixteen different rice varieties grown in upland condition, out of which Sampurna (4628 kg/ha) was found to be high yielder followed by Sama (4320 kg/ha). Similarly, Hardinath-1 (115 days to maturity and yield 3689 kg/ha) and Champion (118 days to maturity and yield 3815 kg/ha was found to be suitable for early harvest. These selected varieties need to be tested over different cropping system for selection of appropriate variety for each cropping system in the western terai for securing higher return by the farmers.

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Authors' Contributions

R. D. Chaudhary designed the research. A. Chaudhary, S. Bohora and R. D. Chaudhary conducted the trial and recorded data. A. Chaudhary, P. Wagle, M. K. Sah and A. Mishra wrote the final manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

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