Original Research Article

Genotype X Environment interaction analysis of rice genotypes under Boro condition for yield contributing traits.

Comment [I1]: conditions

Abstract

An experiment was conducted using 30 rice genotypes along with standard check (Gautam) in two different dates of sowing for twoyear to assess their stability in terms of plant height, spikelets per panicle and grain yield in diverse environments during Rabi 2021-22 and 2022-23. The investigation was undertaken at Pusa Farm of Dr. Rajendra Prasad Agricultural University, Pusa, Samastipur, Bihar under open field conditions in randomized block design with two replications. The results showed that the genotypes like RAU 140118115, RAU 14211532573, RAU 14153576951 and Rajendra Saraswatiare considered as stablefor plant height and spikelets per panicle while for grain yield RAU 1417211517, RAU 1415121743, RAU 141535769534, RAU 141642522, RAU 13972581254, RAU 14171117432, Rasi, Vandana, Boro-3, Rajendra Nilam and Rajendra Laxami was found suitable for average environment and encompasses fair stability and wide adaptation over different environment. RAU 1417211517, RAU 1415121743, RAU 141535769534, RAU 141642522, RAU 13972581254, RAU 14171117432, Rasi, Vandana, Boro-3, Rajendra Nilam and Rajendra Laxami

Comment [I2]: a standard

Comment [I3]: on

Comment [I4]: years

Introduction

Rice (Oryza sativa L.) is a vital crop that serves as a staple food for a significant proportion of the global population. However, its production faces numerous challenges, including the impact of abiotic stresses such as water scarcity and high salinity. These challenges are particularly pronounced during the Boro season, which refers to the winter period in regions characterized by subtropical or tropical monsoon climates. The Boro season is distinguished by a prolonged dry phase followed by waterlogging due to controlled water release from reservoirs or irrigation channels.

The term "boro rice" refers to a specific type of rice that is grown from November to May in low-lying places, taking advantage of the remaining water in the field, the soil's prolonged moisture retention time, and surface water stored in surrounding ditches.Dry season (DS) rice grown during October/November to May/June in the fallow areas after recession of rain or after the harvest of wet season rice or after rice-mustard/potato/vegetable crops, is popularly known as Boro rice in West Bengal and Dalua rice in Orissa. In Assam, Tripura and Manipur, it is classified as Boro and early Ahu depending on the time of cultivation. Early Ahu is of shorter

Comment [I5]: ditches.Dry

Comment [I6]: a recession

duration and requires life-saving irrigation with minimum inputs of fertilisers and pesticides. Ahu rice is cultivated up to an elevation of 600m above mean sea level. Cultivars of varying duration groups are grown by the farmers depending upon their cropping schedule, appropriate utilization of resources, socio-economic condition etc. Dry season rice is the only source of income generation where excess soil moisture does not permit any other crop to be grown successfully. Dry season rice yields are often higher due to availability of more solar radiation, less pest problems and better management practices. It has become the main-stay for food security in the flooded, flood-prone and cyclone-prone areas of Eastern India and Bangladesh.

Low temperatures are frequently experienced by rice plants during the Rabi/Boro season, which can affect seedling development and result in subpar stand formation. Due to the loss of immature seedlings, these detrimental impacts frequently result in poorer seed germination and inconsistent stand establishment. In the present investigation were attempted to identify the way for maximising productivity and characterize the suitability of popular genotypes of different duration groups for their adaptation to Boro ecology based on their performance, consistency, growth behaviour, stability and pest and disease reactions etc under different dates of seeding.

Comment [l7]: investigation attempted

Comment [l8]: the way to maximising

Materials and Methods

Study site and experimental design

The field experiment was conducted during Boro seasons of 2021-22 and 2022-23 at Pusa Farm of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar. The latitude and longitude of the experiment location are 25.980N and 85.670E, respectively. The mean altitude is 52 m above mean sea level.

Treatment details

The research was carried out as under open field (first year) (i)date of sowing 10th Dec 2021, transplanting 5th Feb 2022 and ii) date of sowing 25th Dec 2021, transplanting 20th Feb 2022) in boro season2021-22 and in boro season 2022-23 under open field (Second year) (i)date of sowing 10th Dec 2022, transplanting 5th Feb 2023 and ii) date of sowing 25th Dec 2022, transplanting 20th Feb 2023) at Pusa farm where four different environment conditions named E1, E2, E3 and, E4 respectively, were used for stability study. Thirty rice genotypes and including Gautam ascheck were used for the trial. The experiment was laid out in Randomized Block Design with twice replications and 20X15 cm spacing.

Comment [l9]: carried out under open

Comment [l10]: a check

List 1 :thirty rice genotypes

Sl. no.	Genotypes	SI. no.	Genotypes
G1.	RAU 1417-2-1-1-5-1-7	G16.	RAU 1463-16
G2.	RAU 1415-12-1-7-4-3	G17.	RAU 1397-18-3-7-9-4-7
G3.	RAU 1415-35-76-9-5-3-4	G18.	RAJENDRA BHAGWATI
G4.	RAU 1401-18-1-1	G19.	RASI
G5.	RAU 1401-18-1-1-5	G20.	VANDANA
G6.	RAU 1428-54-35-5-5	G21.	BORO-3

G7.	RAU 1421-12-1-7-4	G22.	RAU 722-14-20
G8.	RAU 1417-9-7-22-5-7-3	G23.	RAJENDRA SARASWATI
G9.	RAU 1451-66-1-1-5-1	G24.	SAHBHAGI
G10.	RAU 1416-4-2-5-2-2	G25.	RAJSHREE
G11.	RAU 1397-2-5-8-1-2-5-4	G26.	RAU 1397-15
G12.	RAU 1417-11-1-74-3-2	G27.	RAU 1415-9
G13.	RAU 1421-15-3-2-5-7-3	G28.	GAUTAM (CHECK)
G14.	RAU 1415-35-7-6-9-5-1	G29.	RAJENDRA NILAM
G15.	RAU 1428-43-2-5-4	G30.	RAJENDRA LAXAMI

Observations recorded

The observation was recorded on Plant height, spikelets per panicle and grain yield (gm/plant). The plant height was recorded on five tagged plants in each genotype from each replication at the time of 50% flowering stage. The spikelets in each paniclewere counted for five selected plants in each replication in all genotype of rice. The grain yield data were collected by using average of five plants from each plot harvested at maturity stage from 30 genotypes of rice. The average data was recorded as gm/plant.

Comment [l11]: genotypes

Comment [l12]: an average

Statistical analysis

The stability model of Eberhart and Russell (1966) were followed for analysis of six environment data. It involves the estimation of three stability parameters like mean ($\bar{X}i$), regression coefficient (bi) and deviation from regression (S^2 di), which are defined by the following mathematical model

Comment [l13]: was

Comment [l14]: environmental

Yij =$\boldsymbol{\mu}$i + βi Ij + δij (I= 1, 2,……..t and j = 1,2……..S)

Where, Yij= Mean of ith genotype injth environment

$\boldsymbol{\mu}$i =Mean of all genotype over all environment

Comment [l15]: genotypes

βi = The regression coefficient of ithgenotype on the environmental index, which measures response of genotype to varying environment

Comment [l16]: ithgenotype

δij= The environmental index which is defined as deviation of the mean of all the genotypes at a given environment from the overall mean.

Comment [l17]: the deviation

The regression coefficients and the mean value for 30 rice genotypes were analysed by R software (metan package).

Result and discussion

Plant height

The data on mean performance of thirty rice genotypes are depicted in table 1. The plant heightdata were ranged from 73.98(RAU139715) to 116.26 (RAU 142112174). The early date of sowing in E1 and E3 were showed significance over the late sown E2 and E4. Likewise considerable variantion was also reported by Shinde and Patel (2014). For Plant height, environment E1 (87.83) was most favourable, followed by E4 (87.95), E2 (88.34) and E3 (89.83). The stability parameters ($\bar{X}$, b_i , and S^2d_i) as proposed by Eberhart and Russell (1966) of the individual genotypes are illustrated in table 2. The genotypes except RAU 1415121743 (84.98), RAU 141535769534 (101.45), RAU 14011811 (111.24), RAU 1428543555 (91.41), RAU 1417112174 (116.26), Rajendra Bhagwati (88.74), Boro-3 (89.63), Rajendra Saraswati (108.94) Sahbhagi (108.14), Rajshree (92.81) and RAU14159 (107.74) mean were shows inferior performance to the population mean (88.48). The examined result shows that RAU 141535769534, RAU 142112174, RAU 141642522, RAU 14211532573 and Rajendra Saraswati showed significant values and are stable genotypes. Genotypes like RAU 141535769534, RAU 140118115, RAU 142112174, RAU 141642522, RAU 14211532573, RAU 14153576951, Boro-3 and Rajendra Saraswati showed significant values i.e stable in favourable environments.

Comment [l18]: data ranged

Comment [l19]: in E1 and E3 showed

Comment [l20]: were shown

Spikelets per panicle

The data on mean performance of thirty rice genotypes are depicted in table 2. The spikelets per apnicle data were ranged from 109.75 (RAU 14179722573) to 207.37 (RAU 13972581254). The early date of sowing in E1 and E3 were showed significance over the late sown E2 and E4. Likewise considerable variation was also reported by (Nayak et al., 2022, y Sreedhar et al. (2011), Shinde and Patel (2014), Haradari et al. (2017) and contrast with Dushyantha Kumar et al. (2010), Swapna et al. (2014). For spikelets per panicle environment E2 (172.93) was most favourable, followed by E4 (1169.63), E1 (168.56) and E3 (165.8). The stability parameters ($\bar{X}$, b_i , and S^2d_i) as proposed by Eberhart and Russell (1966) of the individual genotypes are illustrated in table 3. The genotypes RAU 1417211517 (190.37), RAU 1415121743 (174.12), RAU 141535769534 (183.37), RAU 14011811 (176.87), RAU 140118115 (199.75), RAU 142112174 (176.62), RAU 1451661151 (181.12), RAU 13972581254 (207.37), RAU 14211532573 (169.25), RAU 14153576951 (175.62), RAU 7221420 (206.12), Rajendra Bhagwati (200.12), RAU 139715 (177.00) and RAU 14159 (188.25) were shows superior performance to the population mean (169.23). The examined results shows that RAU 1417211517, RAU 140118115, RAU 14211532573, RAU 14153576951, RAU 13971837947, RAU 7221420, Rajendra Saraswati and RAU 139715 showed are highly significant values and are stable genotypes. Genotypes like RAU 140118115, RAU 141642522, RAU 13971837947, RAU 7221420, Rajendra Saraswati and RAU 139715 showed high significant values i.e highly stable in favourable environments. Mahapatra reported similar results.

Comment [l21]: per panicle data ranged

Comment [l22]: in E1 and E3 showed

Comment [l23]: (188.25) showed

Comment [l24]: The examined results show

Comment [l25]: Mahapatra et al. 1999

Table 1: Mean performance and stability parameters table for the character plant height (cm)

SL. No.	Genotypes	Plant height (cm) E1	E2	E3	E4	$\bar{X}$	b_i	S^2D_i
1.	RAU 1417 2 1 1 5 1 7	82.45	82.75	79.65	80.95	81.45	0.30 ns	-0.39 ns
2.	RAU 1415 12 1 7 4 3	82.85	83.95	86.05	87.05	84.98	1.57 ns	1.42 ns
3.	RAU 1415 35 76 9 5 3 4	112.5	108.75	92.70	91.85	101.45	-1.67*	-4.35 *
4.	RAU 1401 18 1 1	108.4	103.3	118.45	114.80	111.24	-1.60 ns	-3.70 ns
5.	RAU 1401 18 1 1 5	81.2	81.3	94.65	89.25	86.60	-0.74 ns	-6.04 *
6.	RAU 1428 54 35 5 5	85.35	78.7	101.40	100.20	91.41	-0.11 ns	-0.68 ns
7.	RAU 1421 12 1 7 4	109.55	114.2	119.60	121.70	116.26	-1.27*	-3.90*
8.	RAU 1417 9 7 22 5 7 3	96.6	98.45	81.10	74.35	87.63	0.27 ns	0.18 ns
9.	RAU 1451 66 1 1 5 1	78.35	75.85	88.20	88.95	82.84	1.18 ns	-0.14 ns
10.	RAU 1416 4 2 5 2 2	73.95	78.25	92.20	89.75	83.54	0.51*	-0.26*
11.	RAU 1397 2 5 8 1 2 5 4	76.85	76.8	76.05	75.90	76.40	1.55 ns	1.38 ns
12.	RAU 1417 11 1 74 3 2	76.25	80.05	92.45	91.25	85.00	-1.30 ns	-2.98 ns
13.	RAU 1421 15 3 2 5 7 3	73.25	78.7	79.00	82.95	78.48	-1.06 *	-3.41*
14.	RAU 1415 35 7 6 9 5 1	85.55	86.15	77.90	80.05	82.41	-1.25 ns	-6.75 *
15.	RAU 1428 43 2 5 4	88.55	86.2	81.65	80.60	84.25	-0.69 ns	-1.61 ns
16.	RAU 1463 16	102.9	102.25	75.50	71.50	88.04	-1.17 ns	-1.82 ns
17.	RAU 1397 18 3 7 9 4 7	83.6	85	81.55	80.95	82.78	0.30 ns	0.20 ns
18.	Rajendra Bhagwati	80	84.05	97.55	93.35	88.74	0.90 ns	-0.41 ns
19.	Rasi	82.1	79.7	72.40	66.50	75.18	0.51 ns	-0.20 ns
20.	Vandana	100.1	100.7	74.90	70.35	86.51	1.34 ns	1.16 ns
21.	Boro-3	95.5	99.45	83.20	80.35	89.63	-1.56 ns	-4.39 *
22.	RAU 722 14 20	76.2	79.15	92.45	86.85	83.66	-1.95 ns	-3.25 ns
23.	Rajendra Saraswati	100.25	100.65	116.55	118.30	108.94	-1.90 *	-7.30 *
24.	Sahbhagi	98.95	106.15	115.70	111.75	108.14	-1.06 ns	-2.04 ns
25.	Rajshree	87.45	80.45	103.35	100.00	92.81	-0.66 ns	-1.21 ns
26.	RAU 1397 15	78.85	82.6	69.80	64.65	73.98	0.30 ns	0.20 ns
27.	RAU 1415 9	111.25	108.8	108.15	102.75	107.74	0.35 ns	-0.49 ns
28.	Gautam	75.75	78.9	81.85	83.35	79.96	0.43 ns	-0.38 ns
29.	Rajendra Nilam	75.6	73.55	86.00	87.15	80.58	1.59 ns	1.45 ns
30.	Rajendra Laxami	74.75	75.5	74.90	71.10	74.06	-1.52 ns	-3.83 ns
	Environmental Mean	87.83	88.3433	89.83	87.95	88.48		
	C.D (5%)	8.9618	10.3528	7.8197	7.6964			

Table 2 : Mean performance and stability parameters table of character spikelets per panicle.

Spikelets per panicle								
SL. No.	**Genotypes**	**E1**	**E2**	**E3**	**E4**	$\bar{X}$	b_i	S^2D_i
1.	RAU 1417 2 1 1 5 1 7	189.5	194.5	188	189.5	190.37	1.70 *	0.25 ns
2.	RAU 1415 12 1 7 4 3	175	172	174	175.5	174.12	1.58 ns	0.80 ns
3.	RAU 1415 35 76 9 5 3 4	191	179.5	187	176	183.37	0.08 ns	-0.09 ns
4.	RAU 1401 18 1 1	191.5	160	186	170	176.87	0.42 ns	0.16 ns
5.	RAU 1401 18 1 1 5	198.5	214	187	199.5	199.75	1.05 *	0.55 *
6.	RAU 1428 54 35 5 5	146.5	154	146	158.5	151.25	1.37 ns	0.55 ns
7.	RAU 1421 12 1 7 4	182	172.5	179.5	172.5	176.62	0.99 ns	0.28 ns
8.	RAU 1417 9 7 22 5 7 3	112.5	110.5	109.5	106.5	109.75	-0.32 ns	-0.83 ns
9.	RAU 1451 66 1 1 5 1	181.5	183.5	182	177.5	181.12	-1.20 ns	-1.42 ns
10.	RAU 1416 4 2 5 2 2	129	121	130.5	132.5	128.25	1.61 ns	0.33 *
11.	RAU 1397 2 5 8 1 2 5 4	209.5	208.5	201.5	210	207.37	1.90 ns	1.88 ns
12.	RAU 1417 11 1 74 3 2	121	124.5	115	121.5	120.5	-0.24 ns	-0.36 ns
13.	RAU 1421 15 3 2 5 7 3	156.5	193.5	164.5	162.5	169.25	1.16 *	0.42 ns
14.	RAU 1415 35 7 6 9 5 1	144	210.5	149.5	198.5	175.62	1.65 *	0.30 ns
15.	RAU 1428 43 2 5 4	118	106.5	111.5	109	111.25	1.24 ns	0.13 ns
16.	RAU 1463 16	167	150.5	166.5	162.5	161.62	1.09 ns	0.26 ns
17.	RAU 1397 18 3 7 9 4 7	137	167	133.5	159.5	149.25	0.16 *	-0.31*
18.	Rajendra Bhagwati	194	211.5	195.5	199.5	200.12	-1.19 ns	-1.35 ns
19.	Rasi	172	198	172.5	178.5	180.25	1.57 ns	2.14 ns
20.	Vandana	184	208	159.5	197.5	187.25	1.35 ns	0.42 ns
21.	Boro-3	179	153	170	138	160.00	0.05 ns	-0.14 ns
22.	RAU 722 14 20	221	213.5	200	190	206.12	1.33 *	2.19 ns
23.	Rajendra Saraswati	164	153	161.5	177	163.87	1.97 *	1.89 ns
24.	Sahbhagi	198	192.5	190.5	170.5	187.87	1.22 ns	0.44 ns
25.	Rajshree	164.5	161	154	158.5	159.50	1.03 ns	0.24 ns
26.	RAU 1397 15	174	185	169.5	179.5	177.00	0.41*	-0.05 *
27.	RAU 1415 9	191	190.5	178.5	193	188.25	-0.97 ns	-1.23 ns
28.	Gautam	136.5	153	154	163.5	151.75	1.55 ns	0.12 ns
29.	Rajendra Nilam	115.5	141	143.5	142	135.05	0.78 ns	0.11 ns
30.	Rajendra Laxami	191.5	180.5	178.5	193.00	189.50	0.21 ns	0.02 ns
	Environmental Mean	168.5667	172.9333	165.8	169.6333	169.23		
	C.D (5%)	39.3836	39.58	26.7713	22.6779			

Table 3:Mean performance and stability parameters table for the character grain yield (gm/plant)

Grain yield (gm/plant)								
SL. No.	**Genotypes**	**E1**	**E2**	**E3**	**E4**	**$\bar{X}$**	**b_i**	**S^2D_i**
1.	RAU 1417 2 1 1 5 1 7	40.555	44.175	42.03	43.045	42.45	0.04 ns	-9.06 *
2.	RAU 1415 12 1 7 4 3	59.765	56.745	52.04	52.465	55.25	-1.12 ns	-7.59 *
3.	RAU 1415 35 76 9 5 3 4	54.29	51.15	51.18	50.02	51.66	-1.05 ns	-10.23 **
4.	RAU 1401 18 1 1	60.08	63.07	60.025	57.825	60.25	0.44 ns	-0.54 ns
5.	RAU 1401 18 1 1 5	67.13	67.19	61.07	64.425	64.95	-0.08 ns	-0.96 ns
6.	RAU 1428 54 35 5 5	61.205	62.045	57.885	62.11	60.81	0.67 ns	0.50 ns
7.	RAU 1421 12 1 7 4	64.275	63.835	63.265	66	64.34	1.43 ns	0.00 ns
8.	RAU 1417 9 7 22 5 7 3	40.95	42.05	41.045	46.17	42.55	1.05 ns	-0.35 ns
9.	RAU 1451 66 1 1 5 1	59.075	61.755	59.49	57.375	59.42	1.13 ns	0.86 ns
10.	RAU 1416 4 2 5 2 2	51.505	52.7	51.875	50.255	51.58	-0.70 ns	-7.70 *
11.	RAU 1397 2 5 8 1 2 5 4	59.53	64.84	52.985	55.03	58.09	-1.03 ns	-7.13 *
12.	RAU 1417 11 1 74 3 2	69.38	71.23	61.96	66.66	67.30	-1.33 *	-10.55 **
13.	RAU 1421 15 3 2 5 7 3	40.94	42.645	45.125	43.985	43.17	0.68 ns	-0.03 ns
14.	RAU 1415 35 7 6 9 5 1	48.295	48.69	50.01	48.84	48.95	0.16 ns	-0.75 ns
15.	RAU 1428 43 2 5 4	57.555	60.315	58.985	60.18	59.25	0.59 ns	0.32 ns
16.	RAU 1463 16	64.435	59.43	58.325	56.135	59.58	1.06 ns	-0.72 ns
17.	RAU 1397 18 3 7 9 4 7	42.235	43.39	41.855	45.34	43.20	0.91 ns	-0.50 ns
18.	Rajendra Bhagwati	61.815	60.98	59.51	60.625	60.73	1.20 ns	1.07 ns
19.	Rasi	51.455	50.645	50.945	51.095	51.03	0.56 ns	-5.26 *
20.	Vandana	67.115	69.11	64.125	67.425	66.94	-1.76 ns	-6.26 *
21.	Boro-3	62.035	60.145	57.825	57.36	59.34	-1.91 **	-8.46 **
22.	RAU 722 14 20	56.62	62.915	57.055	63.39	59.99	0.50 ns	-0.36 ns
23.	Rajendra Saraswati	71.115	71.775	67.705	71.81	70.60	-0.27 ns	-1.31 ns
24.	Sahbhagi	52.125	52.2	56.515	54.655	53.87	0.67 ns	0.48 ns
25.	Rajshree	46.505	49.93	45.135	48.66	47.55	1.66 ns	0.44 ns
26.	RAU 1397 15	42.615	43.445	42.59	44.995	43.41	0.89 ns	-0.28 ns
27.	RAU 1415 9	41.495	42.715	42.605	42.53	42.33	1.22 ns	0.97 ns
28.	Gautam	48.985	51.045	53.765	55.475	52.31	0.42 ns	-4.11 ns
29.	Rajendra Nilam	47.795	51.215	48.93	51.755	49.92	-1.92 ns	-5.75 *
30.	Rajendra Laxami	42.565	43.48	47.11	45.01	44.54	-1.43 *	-19.33 **
	Environmental Mean	54.1147	55.1618	52.9655	54.2548	54.12		
	C.D (5%)	5.4659	5.8159	5.4037	5.5476			

E1-Environment 1 date of sowing-10th Dec 2021, transplanting-5th Feb 2022, E2- Environment 2 date of sowing-25th Dec 2021, transplanting-20th Feb 2022, E3- Environment 3 date of sowing-10th Dec 2022, transplanting-5th Feb 2023, E4- Environment 4 date of sowing-25th Dec 2022, transplanting-20th Feb 2023, $\overline{X}$=Mean value, b_i =Regression coefficient, S^2D_i = deviation from regression, *= significant at 5% level,**= significant at 0.01% level, C.D= Critical difference.

Grain yield

The data on mean performance of thirty rice genotypes are depicted in table 3. The grain yield data were ranged from 42.33 (RAU 14159) to 70.60 (Rajendra Sarawati). The early date of sowing in E1 and E3 were showed significance over the late sown E2 and E4. Likewise considerable variantion was also reported by (Nayak et al., 2022) . For grain yield (gm/plant), environment E2 (55.16) was most favourable, followed by E4 (54.25), E1 (54.11) and E3 (52.96). The stability parameters ($\overline{X}$, b_i , and S^2d_i) as proposed by Eberhart and Russell (1966) of the individual genotypes are illustrated in table 2. The genotypes viz., RAU 1415121743 (55.25), RAU 14011811 (60.25), RAU 140118115 (64.95), RAU 1428543555 (60.81), RAU 142112174 (64.34), RAU 1451661151 (59.42), RAU 13972581254 (58.09), RAU 14171117432 (67.30), RAU 142843254 (59.25), RAU 146316 (59.58),Rajendra Bhagwati (60.73), Vandana (66.94), Boro-3 (59.34), RAU 7221420 (59.99) and Rajendra Saraswati (70.60) mean were shows superior performance to the population mean (54.12). The examined result shows that RAU 14171117432, Boro-3 and Rajendra Laxamishowed negative highly significant and stable genotypes. Genotypes like RAU 1417211517, RAU 1415121743, RAU 141535769534, RAU 141642522, RAU 13972581254, RAU 14171117432, Rasi, Vandana, Boro-3, Rajendra Nilam and Rajendra Laxami showed high significant values i.e highly stable in favourable environments. (Nayak et al., 2022, Sreedhar et al. (2011), Shinde and Patel (2014), Swapna et al. (2014), Reddy et al. (2015), Pande et al. (2006), Manjunatha et al. (2018), Al-kordy et al. (2019) and Patel et al. (2019)).

Comment [I26]: The grain yield data ranged

Comment [I27]: in E1 and E3 showed

Comment [I28]: (Nayak et al., 2022).

Comment [I29]: were showing

Comment [I30]: Are all these citations necessary? Please indicate its context in the text.

(Nayak et al., 2022, Sreedhar et al. (2011), Shinde and Patel (2014), Swapna et al. (2014), Reddy et al. (2015), Pande et al. (2006), Manjunatha et al. (2018), Al-kordy et al. (2019) and Patel et al. (2019))

Conclusions

Genotypes which have regression coefficient (bi =1), trait mean more than population mean ($\bar{x}>\mu$), small deviation from regression (S2 di) are considered as stable which are RAU 140118115, RAU 14211532573, RAU 14153576951 and Rajendra Saraswatifor plant height and spikelets per panicle while for grain yield RAU 1417211517, RAU 1415121743, RAU 141535769534, RAU 141642522, RAU 13972581254, RAU 14171117432, Rasi, Vandana, Boro-3, Rajendra Nilam and Rajendra Laxamiwas found suitable for average environment and encompasses fair stability and wide adaptation over different environment. RAU 1417211517, RAU 1415121743, RAU 141535769534, RAU 141642522, RAU 13972581254, RAU 14171117432, Rasi, Vandana, Boro-3, Rajendra Nilam and Rajendra Laxami

Reference

Comment [I31]: Please follow the journal's style of writing citations and references.

Hall, V.L. (1996) Temperature and germinating rice seed. I. Minimum to maximum temperature for growth in four days. *Rice J.***69(8)** :40-42.

Bose, L. K., Jambhulkar, N. N., & Pande, K. (2014). Genotype by Environment interaction and stability analysis for rice genotypes under Boro condition. Genetika, 46(2), 521-528.

Dodake, M. M., Intwala, C. G., & Patel, P. B. (2022). Genotype x environment interaction and stability analysis for yield and its contributing traits in rice.

Mahapatra KC and Das S 1999. Stability of yield in relation to component traits in rice. Oryza, 36 (4): 301-305.

Ariyo, O. J., & Ayo-Vaughan, M. A. (2000). Analysis of genotype× environment interaction of okra (Abelmoschus esculentus (L) Moench). *Journal of Genetics & Breeding*, *54*(1), 35-40.

Eberhart, S. T., & Russell, W. A. (1966). Stability parameters for comparing varieties 1. *Crop science*, *6*(1), 36-40.

Reddy VB, Devendra PK, Youshuf A. Stability analysis for yield and its components in promising rice hybrids. The Ecoscan. 2015;9(1-2):311-321.

Manjunatha B, Malleshappa C, Niranjana Kumara B. Stability analysis for yield and yield attributing traits in rice (Oryza sativa L.). Int. J. Curr. Microbiol. App. Sci. 2018;7(6):1629-1638.

Gonya Nayak, P., Sujatha, M., Chandra Mohan, Y., Saida Naik, D., & Kiran Babu, T.(2022) Stability Analysis for Grain Yield and Yield Contributing Traits in Hybrid Rice. Environments, 2(23.47), 596-18.

Shinde, D. A., & Patel, P. B. (2014). Genotype and environment interaction and stability analysis for yield and its contributing traits in rice. ORYZA-An International Journal on Rice, 51(3), 195-203.

Banik, M., Nilanjaya, N., & Sharma, V. K. (2021). Stability Analysis of Fodder Cowpea Genotypes under Different Environments. *Ekin Journal of Crop Breeding and Genetics*, *7*(2), 131-138.

Haradari C, Hittalmani S, Kahani F.(2017) Genotype x environment interaction and stability analysis of yield traits among early generation -pyramid progeny families (EG- PPFS) in rice (Oryza sativa L.). SABRAO J. Breed. Genet. 49(1):44-57.

Pande K, Singh S, Singh ON. (2006) Stability of rice (Oryza sativa L.) varieties for boro season of eastern India. Indian J. Genet. 66(3):191-195.

Shinde DA, Patel PB. (2014) Genotype and environment interaction and stability analysis for yield and its contributing traits in rice. Oryza. 51(3):195-203.

Comment [I32]: It does not appear in the text.

Comment [I33]: It does not appear in the text.

Comment [I34]: It does not appear in the text.

Comment [I35]: It does not appear in the text.

Comment [I36]: It does not appear in the text.

Comment [I37]: Duplicate reference.

Comment [I38]: It does not appear in the text.

Comment [I39]: Duplicate reference.

Sreedhar S, Reddy DT, Ramesha MS. Genotype x environment interaction and stability for yield and its components in hybrid rice cultivars (Oryza sativa L.). Int. J. Plant Breed. Genet. 2011;5(3):194-208.

Al-Kordy MA, Ibrahim HF, El-Mouhamady ABA, Abdel-Rahman HM. Genetic stability analysis and molecular depiction in elite entries of rice (Oryza sativa L.). Bulletin of the National Research Centre. 2019;43:85.

Swapna K, Vanisree S, Raju SC, Sreedhar M. Genotype x environment interaction and stability for yield and quality Characters in Rice (Oryza sativa L.). Madras Agric. J. 2014;101(1-3):21-27.