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B Lalhruaitluangi
Department of Genetics and Plant Breeding, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, Nagaland, India

MB Sharma
Department of Genetics and Plant Breeding, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, Nagaland, India

Pankaj Shah
Department of Genetics and Plant Breeding, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, Nagaland, India

Corresponding Author:
B Lalhruaitluangi
Department of Genetics and Plant Breeding, School of Agricultural Sciences and Rural Development, Nagaland University, Medziphema, Nagaland, India

Correlation studies for yield in different upland rice (*Oryza sativa* L.) genotypes of Nagaland

B Lalhruaitluangi, MB Sharma and Pankaj Shah

Abstract
Yield and yield contributing traits of 28 upland rice genotypes were studied in Experimental Farm, Department of Genetics and Plant Breeding, SASRD, Nagaland University, Medziphema. The experiment was conducted in Kharif 2021 among the yield and yield contributing traits viz., days to 50 percent flowering, days to maturity, plant height (cm), flag leaf length (cm), flag leaf breadth (cm), flag leaf area (cm^2), no. of ear bearing tillers, panicles per plant, panicle length (cm), panicle weight (g), spikelet fertility, root dry weight (g), stem dry weight (g), harvest index, total nitrogen (%), crude protein, 100 grain weight (g) and Grain yield per plant (g). Days to 50% flowering and days to maturity shows positively significant association with grain yield per plant and plant height, flag leaf length and flag leaf area also shows positive significant association with 100 grain weight highlighting the significance of these features as criterion for selection in yield improvement programmes.

Keywords: Rice, correlation coefficient, yield, components of yield

Introduction
One of the world's most significant cereal and staple food crops is rice (*Oryza sativa* L.). Rice is regarded as the most important food crop, particularly in a nation like India. 15% of the protein consumed per person worldwide and 21% of the energy per person worldwide come from rice. Since 70% of the people of Nagaland work in agriculture in some capacity, rice is the primary staple crop there. Their entire area under rice cultivation, which yields 4, 05,180 tonnes of rice, is 1, 83,330 hectares. Unique to upland areas, upland fields can be farmed in rainfed situations without accumulating surface water. It has been gaining popularity as a result of genetic susceptibility, water shortage, and the introduction of pathogen resistance genes as a result of intense cultivation among current high producing cultivars. Given that yield is a complicated characteristic and that the traits that contribute to yield are connected, understanding the correlation coefficient is helpful for carrying out selection in breeding programmes.

Materials and Methods
The experiment was conducted in Kharif 2021 in the Experimental farm, Department of Genetics and Plant Breeding, SASRD, Nagaland University, Medziphema. The experiment was laid out in Randomized Block Design (RBD) with 28 upland rice genotypes collected from SARS, Mokokchung, Nagaland and ICAR for NEH region, Jharnapani. Data were collected in five random plants and datas for 19 quantitative traits were collected such as days to 50 percent flowering, days to maturity, plant height (cm), flag leaf length (cm), flag leaf breadth (cm), flag leaf area (cm2), no. of ear bearing tillers, panicles per plant, panicle length (cm), panicle weight 9g), spikelet fertility, root dry weight (g), stem dry weight (g), harvest index, total nitrogen (%), crude protein, 100 grain weight (g) and Grain yield per plant (g). The data were subjected for analysing correlation coefficient in 19 traits among 28 genotypes. Phenotypic and genotypic correlation coefficient was analysed using WINDOSTAT software and the result was computed as suggested by Al-Jibouri *et al.* (1958) [1]. For disease and pest incidence, plant protection measures will be followed as per recommendations from Package and practices.

Results and Discussion
From the study, the genotypic correlation values were generally higher than the phenotypic correlation values indicating the masking effects of environment on these traits (Table 1 and 2). Similar results were reported by Lakshmi *et al.* 2014 [9].

Table 1: Genotypic Correlation for yield and yield contributing traits

	Days to 50% flowering	**Days to maturity**	**Plant height (cm)**	**Flag leaf length (cm)**	**Flag leaf breadth (cm)**	**Flag leaf area (cm^2)**	**No. of ear bearing tillers (EBT)**	**Panicles/ plant**	**Panicle length (cm)**	**Panicle weight (g)**	**Spikelet fertility**	**Root length (cm)**	**Root dry weight (g)**	**Stem dry weight (g)**	**Harvest Index**	**Total nitrogen (%)**	**Crude protein**	**100 grain weight (g)**	**Grain yield/ plant (g)**
Days to 50% flowering	215.17	0.8	-0.6	-0.19	-29	-0.11	0.43	-0.12	-0.49	0.09	0.02	0.13	-0.24	0.43	0.23	-0.11	-0.11	-0.23	0.31
Days to maturity		183.05	-0.59	-0.11	-0.2	-0.03	0.4	-0.02	-0.623	0.17	-0.09	0.23	-0.06	0.44	0.18	-0.14	-0.14	-0.25	0.26
Plant height (cm)			292.85	0.29	0.3	0.24	-0.49	-0.05	0.41	-0.19	-0.01	0.007	0.43	-0.1	0.02	-0.02	-0.02	0.24	-0.01
Flag leaf length (cm)				44.47	0.49	0.89	-0.23	0.49	0.12	0.19	-0.30**	0.15	0.28	-0.1	-0.14	-0.04	-0.04	0.25	-0.16
Flag leaf breadth (cm)					0.13	0.77	-0.53	0.38	0.25	0.09	-0.37***	0.03	0.42	-0.01	-0.01	-0.31	-0.31	0.18	-0.09
Flag leaf area (cm^2)						267.45	-0.28	0.59	0.12	0.11	-0.38***	0.11	0.35	0.3	-0.07	-0.19	-0.19	0.27	-0.13
No. of ear bearing tillers (EBT)							1.63	0.22	-0.52	-0.03	0.35***	0.13	-0.66	0.02	-0.22	-0.17	-0.17	-0.32	-0.19
Panicles/plant								0.12	-0.13	-0.52	-0.14	0.22	0.15	-0.26	-0.66	-0.2	-0.2	-0.05	-0.76
Panicle length (cm)									12.31	-0.13	0.09	0.15	-0.14	-0.28	-0.2	-0.21	-0.21	-0.1	-0.23
Panicle weight (g)										3.93	0.08	0.28	0.01	-0.19	-0.14	0.18	-0.18	0.14	-0.62
Spikelet fertility											229.19	-0.06	-0.8	-0.04	-0.18	0.002	0.002	-0.25	-0.13
Root length (cm)												2.5	-0.11	0.17	0.15	-0.31	-0.31	0.21	0.75
Root dry weight (g)													0.001	-0.44	-0.29	-0.84	-0.84	0.005	-0.03
Stem dry weight (g)														3.76	0.84	0.16	0.16	-0.04	3.91
Harvest Index															282.01	0.16	0.16	0.89	39.89
Total nitrogen (%)																0.003	1	0.002	0.03
Crude protein																	0.13	0.01	0.17
100 grain weight (g)																		0.71	0.01
Grain yield/ plant (g)																			5.93

Table 2: Phenotypic Correlation for yield and yield contributing traits

	Days to 50% flowering	**Days to maturity**	**Plant height (cm)**	**Flag leaf length (cm)**	**Flag leaf breadth (cm)**	**Flag leaf area (cm^2)**	**No. of ear bearing tillers (EBT)**	**Panicles/ plant**	**Panicle length (cm)**	**Panicle weight (g)**	**Spikelet fertility**	**Root length (cm)**	**Root dry weight (g)**	**Stem dry weight (g)**	**Harvest Index**	**Total nitrogen (%)**	**Crude protein**	**100 grain weight (g)**	**Grain yield/ plant (g)**
Days to 50% flowering	215.88	0.80***	0.58***	-0.18	-0.27	-0.1	0.39***	-0.06	-0.43***	0.0`8	0.03	0.12	-0.09	0.41***	0.23*	-0.1	-0.1	-0.23*	0.31**
Days to maturity		183.07	0.57***	-0.1	-0.2	-0.03	0.37***	-0.01	-0.55***	0.17	-0.09	0.21*	-0.02	0.42***	0.18	-0.13	-0.13	-0.25*	0.26*
Plant height (cm)			313.68	0.27*	0.29**	0.23*	-0.43***	0.03	0.35**	-0.17	-0.01	0.01	0.11	-0.09	0.03	-0.02	-0.21	0.23*	-0.003
Flag leaf length (cm)				51.95	0.42***	-0.85***	-0.23*	0.2	0.13	0.17	-0.31**	0.11	0.07	-0.1	-0.13	-0.05	-0.05	0.22*	-0.15
Flag leaf breadth (cm)					0.14	-0.72***	-0.44***	0.18	0.18	0.08	-0.37***	0.02	0.18	-0.02	-0.01	-0.29**	-0.29**	0.17	-0.08
Flag leaf area (cm^2)						295.48	-0.27*	0.26*	0.11	0.09	-0.38***	0.11	0.01	0.03	-0.07	-0.18	-0.18	0.25*	-0.12
No. of ear bearing tillers (EBT)							1.91	0.11	-0.19	-0.003	-0.36***	0.14	-0.25*	0.04	-0.19	-0.15	-0.15	-0.29**	-0.18
Panicles/plant								0.62	0.06	-0.23*	-0.14	-0.07	0.06	-0.08	-0.27*	-0.06	-0.06	-0.03	-0.31**
Panicle length (cm)									15.69	-0.1	0.09	-0.12	-0.1	-0.24*	-0.19	-0.18	-0.18	-0.02	-0.21
Panicle weight (g)										4.25	0.09	0.27*	0.01	-0.18	-0.13	-0.17	-0.17	-0.13	-0.06
Spikelet fertility											229.19	-0.02	-0.23*	-0.01	-0.11	-0.01	-0.01	-0.14	-0.09
Root length (cm)												2.8	-0.15	0.17	0.14	-0.30**	-0.3**	0.23	0.75
Root dry weight (g)													0.006	-0.18	-0.13	-0.31**	-0.31**	0.005	-0.03
Stem dry weight (g)														3.98	0.82***	0.16	0.16	-0.04	3.92
Harvest Index															282.99	0.16	0.16	0.89	40
Total nitrogen (%)																0.004	1***	0.002	0.03
Crude protein																	0.14	0.01	0.17
100 grain weight (g)																		0.72	0.01
Grain yield/ plant (g)																			5.95

Significance at 5%-*, Significance at 1%- **, Significance at 0.1%- *** respectively

No. of ear bearing tillers have significant positive association with spikelet whereas flag leaf length, flag leaf breadth and flag leaf area have negative significant association with spikelet fertility.

Days to 50 percent flowering has positive significant association with days to maturity (Debchoudhary and Das, 1998; Lakshmi *et al*., 2014) [9] plant height (Sawant *et al*., 1995) [14], no. of ear bearing tillers, harvest index, stem dry weight and grain yield per plant showing the potential for simultaneous enhancement of the qualities. But negative association was observed in panicle length and 100 grain weight.

Similarly, day to maturity also have significant positive association with plant height (Sawant *et al*., 1995; Deepa *et al*., (2006); Singh *et al.*, 2006; Lakshmi *et al*., 2014) [14, 4, 16, 9] no. of ear bearing tillers, stem dry weight and grain yield (Debchoudhary and Das, 1998; Deepa *et al*., (2006) [4]; Singh *et al.*, 2006; Lakshmi *et al*., 2014) [16, 9]. But negative significant association was observed in panicle length and 100 grain weight.

Plant height also have significant positive association with flag leaf length, flag leaf breadth, flag leaf area, panicle length (Mirza *et al*., 1992; Chaubey and Singh, 1994; Nayak *et al*., 2001; Kole *et al*., 2008; Khan *et al*., 2009; Sadeghi, 2011; Ravindra Babu *et al*., 2012; Hossain *et al*., 2018, Singh *et al*., 2018) [10, 2, 11, 8, 7, 13, 12, 6, 15] and 100 grain weight (Lakshmi *et al*., 2014) [9]. But plant height shows negative significant association with no. of ear bearing tillers.

Flag leaf length also have significant positive association with flag leaf breadth, flag leaf area and 100 grain weight but negative significant association with spikelet fertility, flag leaf area and no. of ear bearing tillers. Flag leaf breadth shows negative significant association with flag leaf area, no. of ear bearing tillers, spikelet fertility, total nitrogen and crude protein. Flag leaf area also shows positive significant association with panicles per plant 100 grain weight. Panicles per plant show negative significant association with panicle weight, harvest index and grain yield per plant. Panicle weight also shows positive significant association with root length.

Stem dry weight shows positive significant association with harvest index and total nitrogen with crude protein demonstrating the significance of these qualities as a selection criterion in programmes for yield increase.

Conclusion

Our results obtained from twenty eight rice genotypes with nineteen traits revealed that days to 50% flowering and days to maturity shows positively significant association with grain yield and plant height, flag leaf length and flag leaf area also shows positive significant association with 100 grain weight. Therefore, days to 50% flowering, days to maturity, plant height, flag leaf length and flag leaf area are the important traits to be considered for yield improvement in breeding programmes.

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