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Correlation coefficient of yield traits in Advanced breeding lines under drought stress

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ABSTRACT
The correlation coefficient was estimated for various yield traits in advanced mapping population (F_4) raised from the cross between ARC10372 and Ranjit under drought stress and irrigated conditions. The panicle associated traits were mainly considered as these are the major contributors for grain yield in rice. Number of grains per panicle showed significant positive correlation with spikelet fertility, grain yield per plant and relative leaf water content (RLWC) under drought stress condition. The maintenance of proper seed setting under drought stress is an indicator of drought tolerance and it was observed higher in drought tolerant genotypes. Grain yield showed positive correlation with number of grains per panicle and spikelet fertility under the two different hydrological conditions. Under irrigated conditions, grain yield showed positive correlation with days to 50% flowering however, under drought stress negative correlation was observed among the traits. Therefore, the late flowering genotypes suffered from significant yield loss under drought stress.
Key words, Rice, correlation coefficient, yield traits, drought tolerance

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INTRODUCTION

Drought is one of the most important abiotic stresses which limit rice production in rainfed environment. Rice is the most important crop in Assam and covers 2.54 million (M) ha of the total 3.3 M ha cropped area. It is a semi-aquatic crop and more prone to losses from drought than other cereals such as wheat and maize, which are better adapted to be grown with less water. Despite of heavy rainfall in the state, the main rice crop suffers from prolonged drought in *ahu* season and intermittent drought in *sali* season. Assam has extremely diverse rice growing conditions as compared to other parts of the country therefore, rich in diverse accessions which are supposed to have tolerance for various biotic and abiotic stresses. The popular rice variety 'Ranjit' is widely grown in Assam due to its suitable plant type and high grain yield but it is highly susceptible to drought stress during reproductive stage, resulting in significant yield loss even under mild stress conditions. As such the traditional drought tolerant *ahu* rice accessions can be successfully exploited in breeding programme for development of drought tolerant rice variety for the rainfed drought prone areas of Assam. In crop improvement programme the crosses between the genotypes with maximum genetic divergence are advantageous as they are likely to yield desirable recombinants in the progeny. In the present investigation a low yielding, short duration, drought tolerant cultivar, ARC10372 was crossed with a long duration, high yielding, drought susceptible variety, Ranjit in order to develop high yielding drought tolerant phenotypes.

Previously, secondary yield component traits and physiological traits were used as selection criteria for improving grain yield under drought in rice (Jongdee *et al*., 2002). However, desired improvement in grain yield could not be achieved through selection for secondary traits. Hence, grain yield under drought stress has been suggested as a selection parameter in drought breeding (Bernier *et al*., 2008). However, the low heritability of grain yield makes selection for this trait difficult. But selection for high yielding varieties is possible using various components traits associated with yield (Atlin, 2003). Therefore, in the present study the F_4 population were evaluated for various yield component traits under drought stress and irrigated conditions. These traits were considered for correlation analysis in order to study their

importance in relation to yield under two different hydrological conditions as well as for use in indirect selection of grain yield in order to identify high yielding plants under drought stress.

MATERIAL AND METHODS

A drought tolerant parent 'ARC10372' was used as a female parent and a drought susceptible parent 'Ranjit' was used as a male parent for development of advanced mapping populations. The advanced population (F_4) were evaluated for various yield traits under drought stress in rainout shelter and non stress (irrigated conditions) in the field following Randomized Complete Block Design with three replications during *rabi* season (December 2015-July 2016). The varieties Sahbhagi Dhan, Nerica and Banglami were used as drought tolerant checks for phenotypic evaluation. Drought stress was imposed from panicle initiation to panicle emergence period (reproductive stage) by withholding irrigation as described by Kumar *et al*. (2014). Data on various yield traits were recorded at maturity from the trials conducted under both hydrological conditions and reported by Verma *et al*. (article under peer-review). The Pearson correlation among the traits was analysed by using SPSS version 15.0.

RESULTS AND DISCUSSION

The results in table 1 and table 2 revealed that days to 50per cent flowering showed significant positive correlation with number of tillers per plant (0.523*), number of grains per panicle (0.592*) and grain yield (0.526*) under irrigated conditions. However, under drought stress it showed negative correlation with the grain yield per plant (-0.151). This suggests that under the influence of drought stress flowering is delayed in plants. Lafitte *et al*. (2004) reported that the flowering delay is mainly caused by a combination of slower floral development and reduced panicle elongation rate under stress. The traits such as panicle length, number of tillers per hill, number of spikelets per panicle, plant height are the main contributors to grain yield. Therefore, significant reduction in the grain yield was observed in the drought susceptible variety Ranjit as reported by Verma *et al*. (2017). Effective booting tillers showed significant positive correlation with number of tillers per plant (0.723**) and panicle length (0.665**) under drought stress. It also had significant positive correlation with number of tillers per plant (0.989**) under irrigated conditions. Gunasekaran *et al*. (2010) reported that the effective tillers followed by filled grains per panicle are the important characters to improve the yield potential in rice.

In the present study the traits associated with the panicles were mainly considered under both conditions in order to achieve high grain yield. Similarly Kumar *et al*. (2008) also reported that the panicle associated traits were more reliable for indirect selection of grain yield under stress in both upland and lowland conditions. Under drought stress, panicle length showed significant positive correlation with effective booting tillers per plant (0.665**), plant height (0.603*), spikelet fertility (0.553*) and significant negative correlation with number of chaff per panicle (-0.537*). Mirza *et al*. (1992) reported positive correlation of panicle length with number of grains per panicle under drought stress conditions; therefore, plants with medium to long panicles were preferred under drought stress in order to achieve high grain yield per plant. Number of grains per panicle showed significant positive correlation with spikelet fertility (0.586*), grain yield (0.684**), RLWC (0.688**) under drought stress conditions. It showed significant positive correlation with days to 50 per cent flowering (0.592*), panicle length (0.531**) spikelet fertility (0.543*) and grain yield (0.824**) under irrigated conditions. Higher number of grains per panicle was observed in the drought tolerant cultivars such as ARC10372, Banglami, Sahbhagi Dhan and Nerica as reported by Verma *et al*. (2017) which results in high grain yield per plant in these cultivars under drought stress. Naseem *et al*. (2014) reported the positive correlation between number of grains per panicle and grain yield per plant in the field conditions. Number of chaff per panicle showed significant negative correlation with panicle length (-0.537**) and spikelet fertility (-0.886**) under drought stress. It had significant negative correlation with spikelet fertility (-0.919*) under irrigated conditions. The drought susceptible variety (Ranjit) had more number of chaff per panicle under drought stress conditions and therefore, it showed significant decline in spikelet fertility and grain yield relative to the irrigated conditions (Verma *et al*., 2017).

Spikelet fertility showed significant positive correlation with panicle length (0.553*) and number of grains per panicle (0.586*); whereas, it showed significant negative correlation with number of chaff per panicle (-0.886**) under drought stress. Similarly, under irrigated conditions it showed significant positive correlation with panicle length (0.563*), number of grains per panicle (0.543*) and negative correlation with number of chaff per panicle (-0.919**). The main cause of yield reduction under drought stress during flowering is spikelet sterility as reported by Liu *et al*. (2006). Therefore, the high spikelet fertility maintained by drought tolerant cultivars under drought stress condition was the major reason of its yield stability over the susceptible cultivar. The spikelet fertility was observed higher in ARC10372 (80.95%), Banglami (84.88%), Sahbhagi Dhan (81.87%) and Nerica (61.45%) whereas, only 22.58% in

Ranjit under drought stress conditions as reported by Verma *et al*. (2017). Similarly, Lanceras *et al*. (2004) reported the genetic improvement in grain yield under stress would be accompanied by improvement in panicle characters and spikelet fertility.

The Relative leaf water content (RLWC) had significant positive correlation with number of grains per panicle (0.688**) and positive correlation with spikelet fertility (0.508) and grain yield (0.345) under drought stress. The maintenance of a relatively high RLWC is an indicator of drought tolerance (Altinkut *et al*., 2001) and observed higher in the drought tolerant cultivars *viz*., ARC10372 (75.68%), Banglami (70.00%), Sahbhagi Dhan (72.45%) and Nerica (82.45%) as reported by Verma *et al*. (2017). Grain yield showed significant positive correlation with number of grains per panicle (0.684**) and positive correlation with spikelet fertility (0.493) under drought stress. It had significant positive correlation with days to 50 per cent flowering (0.526*), panicle length (0.545*) and number of grains per panicle (0.824**) under irrigated conditions. Suji *et al.* (2012) also reported the significant positive correlation of grain yield with plant height, number of effective booting tillers and spikelet fertility under drought stress. It indicates that the yield differences which were observed under drought stress are mostly the results of large difference in the capacity of plants to maintain proper seed setting under stress, irrespective of the vegetative growth. As a result of this higher grain yield was observed in the short duration drought tolerant cultivars ARC10372, Banglami, Sahbhagi Dhan and Nerica under drought stress Verma *et al*. (2017). Thus, the grain yield per plant can be improved through selection for the traits *viz.*, number of grains per panicle and spikelet fertility under drought stress conditions.

CONCLUSION

The present study indicated the existence of genetic variation for yield components in the material studied. The trait 'high grain yield per plant under drought stress' was achieved through more number of 'grains per panicle' and 'high spikelet fertility'. Therefore, these two panicle associated traits are the major contributor for high grain yield and can be used for indirect selection of grain yield under drought stress conditions.

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REFERENCES

1. Altinkut, A., Kazan, K., Ipekei, Z., Gozukirmizi, N. 2001. Tolerance to paraquate is correlated with the traits associated with water stress tolerance in segregating F_2 populations of barley and wheat. Euphytica 121: 81-86.
2. Atlin, G. 2003. Improving Drought Tolerance by Selecting for yield. In: Breeding Rice for Drought-prone Environments, Fisher, K.S., R. Lafitte, S. Fukai, G. Atlin and B. Hardy (Eds). Los Banos, The Philippines, pp: 14-22.
3. Bernier, J., Atlin, G.N., Serraj, R., Kumar, A. and Spaner, D. 2008. Breeding upland rice for drought resistance. J. Sci. Food Agric. 88: 927-939.
4. Gunasekaran, M., Nadarajan, N., Netaji, S.V.S.R.K. 2010. Character association and path analysis in inter-racial hybrids in rice (*Oryza Sativa* L.). Elect. J. Plant Breed 1: 956-960.
5. Jongdee, B., Fukai, S. and Cooper, M. 2002. Leaf water potential and osmotic adjustment as physiological traits to improve drought tolerance in rice. Field Crops Res. 76: 153-163.
6. Kumar, A., Bernier, J., Verulkar, S., Lafitte, H.R., Atlin, G.N. 2008. Breeding for drought tolerance: direct selection for yield, response to selection and use of drought-tolerant donors in upland and lowland-adapted populations. Field Crop. Res. 107: 221-231.
7. Kumar, A., Dixit, S., Ram, T., Yadaw, R.B., Mishra, K.K., Mandal, N.P. 2014. Breeding high-yielding drought-tolerant rice: genetic variations and conventional and molecular approaches. J. Exp. Bot 65: 6265-6278.
8. Lafitte, H.R., Price, A.H., Courtois, B. 2004. Yield response to water deficit in an upland rice mapping population: associations among traits and genetic markers. Theor. Appl. Genet 109: 1237-1246.
9. Lanceras, J.C., Pantuwan, G., Jongdee, B., Toojinda, T. 2004. Quantitative trait loci associated with drought tolerance at reproductive stage in rice. Plant Physiol 135: 384-399.
10. Liu, J.K., Liao, D.Q., Oane, R., Estenor, L., Yang, X.E., Li, Z.C., Bennett, J. 2006. Genetic variation in the sensitivity of anther dehiscence to drought stress in rice. Field Crop Res 97: 87-100.
11. Mirza, M.J., Faiz, F.A., Majid, A. 1992. Correlation studies and path analysis of plant height, yield and yield components in rice (*Oryza sativa* L.). Sarhad J. Agril 8: 647-653.
12. Naseem, I., Khan, A.S., Akhter, M. 2014. Correlation and path coefficient studies of some yield related traits in rice (*Oryza sativa* L.). Int. J. Sci. Res. Pub. 4.
13. Verma, R.K., Chetia, S.K., Dey, P. C., Sharma, V., Baruah, A. R., Modi, M. K. Development of advanced breeding lines for high grain yield under drought stress in elite rice genetic background. Res. Crop. (article under peer-review).
14. Verma, R.K., Chetia, S.K., Dey, P. C., Baruah, A. R., Modi, M. K. 2017. Mapping of QTLs for grain yield and its component traits under drought stress in elite rice variety of Assam. *Int. J. Curr. Microbiol. App. Sci.* 6: 1443-1455.

15. Suji, K.K., Biji, K.R., Poornima, R., Prince, K.S.J., Amudha, K., Kavitha, S., Mankar, S., Babu, R.C. 2012. Mapping QTLs for plant phenology and production traits using indica rice (*Oryza sativa* L.) lines adapted to rainfed environment. Mol. Biotechnol 52: 151-160.

Table 1: Correlation coefficient among the yield traits in F_4 population under drought stress

	DTF	NOT	EBT	PH(cm)	PL(cm)	NOG	NOC	SF	GY (g/p)	RLWC
DTF	1									
NOT	0.198	1								
EBT	-0.014	0.723**	1							
PH	-0.511	0.389	0.467	1						
PL	-0.436	0.285	0.665**	0.603*	1					
NOG	-0.232	-0.474	-0.138	-0.091	0.141	1				
NOC	0.481	0.237	-0.205	-0.250	-0.537*	-0.256	1			
SF	-0.461	-0.247	0.210	0.293	0.553*	0.586*	-0.886**	1		
GY	-0.151	-0.131	0.250	-0.019	0.346	0.684**	-0.264	0.493	1	
RLWC	0.165	-0.333	-0.022	-0.314	0.016	0.688**	-0.248	0.508	0.345	1

Table 2: Correlation coefficient among the yield traits in F_4 population under irrigated conditions

	DTF	NOT	EBT	PH(cm)	PL(cm)	NOG	NOC	SF	GY (g/p)	RLWC
DTF	1									
NOT	0.523*	1								
EBT	0.447	0.989**	1							
PH	-0.018	-0.247	-0.222	1						
PL	0.004	-0.0246	-0.224	0.567*	1					
NOG	0.592*	0.448	0.399	0.266	0.531*	1				
NOC	0.304	0.268	0.263	-0.297	-0.372	-0.200	1			
SF	-0.041	-0.097	-0.099	0.385	0.563*	0.543*	-0.919*	1		
GY	0.526*	0.311	0.267	0.294	0.545*	0.824**	-0.137	0.443	1	
RLWC	0.046	-0.020	-0.044	-0.251	-0.288	-0.113	-0.216	0.105	-0.224	1

** Correlation is significant at 0.01 level, * correlation is significant at the 0.05 level, DTF- Days to 50% flowering, NOT- No. of tillers per plant, EBT- Effective booting tillers per plant, PH-Plant Height (cm), PL- Panicle length (cm), NOG- Number of Grains per panicle, NOC- Number of chaffs per panicle, SF- Spikelet fertility, GYP- Grain yield per plant, RLWC- Relative leaf water content

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