JCBPS; Section B; August 2017 – October 2017, Vol. 7, No. 4; 1152-1160. E- ISSN: 2249 –1929
[DOI: 10.24214/jcbps.B.7.4.115260.]

Journal of Chemical, Biological and Physical Sciences

An International Peer Review E-3 Journal of Sciences

Available online atwww.jcbsc.org

Section B: Biological Sciences

CODEN (USA): JCBPAT Research Article

Study of Phenotypic Correlations of Some Selected Fine Rice (*Oryza Sativa* L.) Genotypes

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Received: 04 July 2017**; Revised:** 11 August 2017**; Accepted:** 15 August 2017

Abstract: An experiment was conducted at the research field of the Department of Genetics and Plant Breeding of Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur to evaluate the phenotypic correlations between some traits and yield components of nine fine rice cultivars and also to determine the most effective factors on its yield. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The nine fine rice cultivars namely Salsira, Binni pakri, Bolder, Joitha kathari, Ukni modhu, Salna, Radhuni pagol, BRRI 49 and Katarivog were evaluated. Analysis of variability parameters elucidate that the phenotypic coefficient of variation was higher than genotypic coefficient of variation for most of the trait studied. The plant height, non-filled grain number/panicle and yield showed high heritability and spikelet length showed low heritability. Yield displayed positive significant correlation with of spikelet length and days to 50% flowering but showed non-significant correlation with other traits.

Keywords: Fine rice, Cultivars, Phenotype, Correlations

INTRODUCTION

From time, immemorial Bangladesh is rich in diversified rice landraces, since rice plays a vital role in the livelihood, socio-economic and cultural aspects across the globe. The Rice genus *Oryza*, is divided into four species i.e. *O. sativa, O. officialis, O. ridelyi* and *O. granulate* [1]. This genus contains 25 recognized species among those 23 are wild species and two are cultivated species namely; O. *Sativa and O. glaberrima.* In rice based cropping system of Bangladesh thousands of local rice varieties are being cultivated from the time immemorial [2]. From Bangladesh, International Rice Research Institute (IRRI) gene bank collected more than 8,000 traditional rice varieties [3]. To date, farmers are used to cultivate different local varieties or landraces particularly in the unfavorable ecosystems across the country. In the rice growing areas of Bangladesh the local variety including aromatic rice genotypes occupied about 12.16% [4]. Many of these local varieties provide additional value in socioeconomic aspects as they have some special characteristics such as aroma, better taste, and higher cooking quality also. Besides, aromatic rice is well known to many countries of the world for their aroma and/or super fine grain quality [5]. Bangladesh has a stock of above 8,000 rice germplasms of which nearly 100 are aromatic [2, 6]. Aromatic rice is consumed during weddings and other festivals in Bangladesh [7]. The native aromatic and fine rice germplasm of Bangladesh generally have short bold and medium bold grain type with mild to strong aroma [8, 9]. Among different aromatic rice varieties of Bangladesh, the Chinigura variety solely covers more than 70% of rice farms in the northern districts of Naogaon and Dinajpur. Other important aromatic rice varieties are Kalijira (predominantly grown in Mymensingh) and Kataribhog (mainly cultivated in Dinajpur) [10]. Most of the aromatic rice varieties in Bangladesh are grown during Aman season under rainfed lowland ecosystem and they are locally adapted, photoperiod-sensitive. The production cost of aromatic and fine rice is comparatively lower than coarse rice. Therefore, the income potential is higher with aromatic fine rice cultivation, since its cultivation does not usually require additional expenditures on fertilizer, pesticides, and irrigation. However, though the average yield of high yielding rainfed lowland rice is high (3.4 t/ha), [11] than that of aromatic rice but the market price of aromatic rice is almost double than coarse rice.

The knowledge on genetic diversity among crop species and its quantitative assessment usually helps a breeder to select suitable parents to be utilized in breeding programmes [12-17]. In a breeding programme, genetic improvement primarily depends upon the amount of genetic variability present in the population. In many cases, quantitative characters are polygenic which are highly influenced by the environment. So, it is difficult to predict whether the existing variability is heritable or not. Additionally, for selection for a specific character high genetic advance coupled with high heritability offers the most effective condition [18]. The measurement of correlation coefficient helps to identify the relative contribution of the component characters towards yield. From values measured in the field and are the result of genetic and environmental causes the phenotypic correlations are directly estimated. To guide breeding programs only the genetic portion of phenotypic correlations is used as it represents the only component of inheritable nature. For genetic breeding correlation studies provide important information, since they enable to identify and determine the proportion of the phenotypic correlation that is associated with genetic causes, to verify whether the selection for a certain trait influences another one, to quantify indirect gains due to selection on correlated traits, and to evaluate the complexity of the traits [19, 20]. Therefore, it is very important to a plant breeder to have the information about yield contributing traits for development of improved varieties or lines of rice with increased yield potential. Keeping these points in view the current study was undertaken to characterize and evaluate the selected fine rice genotypes.

MATERIALS AND METHODS

Nine aromatic rice genotypes namely Salsira, Binni pakri, Bolder, Joitha kathari, Ukni modhu, Salna, Radhuni pagol, BRRI 49 and Katarivog were used in this investigation. The seeds genotypes were collected from the Genetics and Plant Breeding laboratory of Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh. The experiment was conducted in the plant breeding research field, Department of genetics and plant breeding, Hajee Mohammad Danesh Science and Technology University, Dinajpur during the Aman season (June-Dec) of 2016. The experimental field was located at 24.00^0 N latitude and 90.25^0 E longitudes at an altitude of 34m from the sea level. The land belonged to the agro-ecological region AEZ-1 (Old Himalayan Piedmont Plain) [21]. The experimental plots were laid out in randomized complete block design with three replications. Each replication contained 150 hills of each cultivar having 20cm×20cm spacing. The unit plot size was (6×3 m^2). Rice production procedures recommended by Bangladesh Agricultural Research Council [22] was followed. The chemical fertilizers like Urea, TSP, MOP and Gypsum were applied at the rate of 210 kg, 185 kg, 100 kg, and 20 kg ha^{-1}, respectively. Full doses of TSP and MOP and gypsum with one half of urea were applied at the final land preparation. The remaining amount of urea was applied in two splits, one at tillering and the other at booting stages. Between two adjacent seedbeds a 50-cm drainage channel was allowed to drain out excess water whenever needed. The seeds were soaked in water for 24 hours and then incubated in a moist jute sack for 48 hours with a view of quick germination. After establishing the roots, the seed beds were irrigated to a depth of 2-3 cm. To attain water depth of 5 cm excess water was occasionally drained out that partially controlled weeds, and the remaining weeds were removed to raise healthy and vigorous seedlings. Intercultural operations like weeding, plant protection practices were done as per need. Harvesting was done when 90% of the grains became golden yellow color. Data were collected on plant height (cm), tillers/hill (at maximum vegetative stage), panicle length (cm), number of grain/panicle, number of non-filled grain/panicle, days to 50% flowering, days to maturity, racillae/panicle, spikelet length (mm) and yield (t/ha). After the appearance of 70% of the panicles, days to flowering have been recorded as soon as possible. Number of tillers was recorded after emerging the fertile panicles and grain development. The plant height was measured from ground level to the tip of the longest panicle. At maturity, panicles were harvested separately and placed individually in an envelope. The panicles were taken out of the envelopes and air-dried for one week at room temperature. The recorded data were analyzed by using the statistical program SPSS (Version 16.0, 2007).

RESULTS AND DISCUSSION

The analysis of variance of the traits on viz. plant height (cm), tillers/hill, panicle length (cm), number of grain/panicle, number of non-filled grain/panicle, days to 50% flowering, days to maturity, racillae /panicle, spikelet length (mm) and yield (t/ha) shown in **Table-1**. The result indicates that there was significant variation among the genotypes for all the traits indicating considerable amount of genetic variation exist in the experimental materials. So, there has a great scope for the improvement of such traits through selection of the genotypes. The value of co-efficient of variation was low for most of the traits but differed from the lowest value (1.73%) in yield (t/ha) to the highest (10.81%) in tillers/hill. The plant height of the genotypes was ranged from 119.50-164.94 cm. The average plant height of the aromatic rice is 146.35 [23]. The highest tillers/hill was observed in Bolder (22.74) and lowest in Katarivog (16.09).

Table-1: Analysis of variance (MS) on different traits of the selected cultivars

Sl. No.	Traits	**Source of variation with mean sum of square**			
		Replication (2 df)	Genotype (7 df)	Error (14 df)	Coefficient of variation (%)
1	Plant height (cm)	0.24	10.77**	42.9412	4.44
2	Tillers/hill	1.76	3.64**	4.6074	10.81
3	Panicle length (cm)	0.37	1.49**	4.3914	8.98
4	Rachillae/panicle	0.884	6.51**	1.502	10.06
5	Grain number/panicle	0.03	4.58**	130.3962	7.73
6	Non-filled grain number/panicle	3.49	23.43**	4.4971	10.55
7	Days to 50% flowering	1.81	5.44**	10.4028	2.93
8	Days to maturity	0.30	5.43**	9.4028	2.26
9	Spikelet length	6.22	2.20**	0.0133	1.86
10	Yield (t/ha)	0.40	20.76**	0.0029	1.73

***Significant at 5% level of probability, **Significant at 1% level of probability**

As an important yield contributing character, BRRI 49 produced the highest panicle length (25.96 cm) which is statistically similar with Binni pakri and Katarivog where lowest value was recorded in Joitha kathari (21.00 cm). Though all the studied genotype produced the statistically similar value of grain number/panicle except Ukni modhu which produced lower value (122.57), BRRI 49 produced the maximum grain number/panicle (164.94). The maximum non-filled grain number/panicle was found in Salsira (29.38) and minimum in Ukni modhu (11.45) where others produced the similar performance. BRRI 49 produced the highest value of days to 50% flowering (116.33) and lowest from the Binni pakri (106.33) and Radhuni pagol (105.67). In case of days to maturity most of the genotypes produced the similar performance. The racillae/panicle was highest in Bolder (14.00) and lowest in Binni pakri (10.02). The maximum spikelet length was recorded in BRRI 49 (13.65) statistically similar with Salna but the minimum value was recorded in Bolder (9.6). However, the most economically important character, yield (t/ha) was ranged between 3.97-4.7 t/ha. The highest yield (t/ha) was recorded in Katarivog (3.47 t/ha) followed by Salna (3.17 t/ha) and lowest was in Joitha katari (2.97 t/ha) **Table-2**. Again, variability of different traits of the rice genotypes are shown in **Table-3**. Significant differentiation was noticed among the genotypes for all the trait studied. It revealed the presence of large genetic variation among the tested genotypes. The values of phenotypic and genotypic co-efficient of variation higher than 20% are regarded as high, whereas values less than 10% are considered to be low and values between 10 and 20% to be medium [24]. In case of plant height, the minimum difference between phenotypic and genotypic indicates minimum environmental influence on this trait. Among the different traits only the non-filled grain number/panicle showed more than 20% variation at phenotypic level (30.727), which could be considered as high and tillers/hill, rachillae/panicle with grain number/panicle displayed medium variation (10-20%) where rest traits showed lower variation (>10%) (**Table-3**).

Table-2: Mean performance of different traits of the selected cultivar

Cultivars	Plant height (cm)	Tillers/hill	Panicle length (cm)	Grain number /panicle	Non-filled grain number /panicle	Days to 50% flowering	Days to maturity	Racillae / panicle	Spikelets length	Yield
Salsira	139.95 b	15.74 b	22.07 b	151.74 abc	29.38 a	109.00 abc	135.33 ab	13.47 a	11.65 b	3.08 bcd
Binni pakri	149.39 ab	16.87 ab	22.94 a	149.97 abc	19.34 cde	106.33 c	129.00 b	10.02 c	11.87 ab	3.12 bcd
Bolder	146.77 ab	22.74 a	23.36 b	142.87 abc	21.95 bcd	106.67 bc	132.33 ab	14.00 a	9.60 c	3.14 bc
Joitha kathari	119.50 c	18.74 ab	21.00 c	128.44 bc	14.52 ef	107.00 abc	130.67 b	11.99 b	12.30 ab	2.97 d
Ukni modhu	151.30 ab	20.11 ab	22.29 b	122.57 c	11.45 f	110.33 abc	137.00 ab	13.25 a	11.50 ab	3.01 cd
Salna	154.44 ab	19.90 ab	23.73 b	159.26 ab	24.06 abc	114.67 abc	139.67 a	10.60 c	13.33 a	3.17 b
Radhuni pagol	150.68 ab	16.18 b	24.42 b	154.95 abc	16. 32 def	105.67 c	136.00 ab	11.00 b	11.11 b	3.12 bcd
BRRI 49	164.94 a	17.24 ab	25.96 a	164.94 a	26.85 ab	116.33 a	140.33 a	13.55 a	13.65 a	3.08 bcd
Katarivog	150.82 ab	16.09 b	24.28 a	155.58 abc	16.65 def	116.00 ab	139.67 a	10.34 c	11.34 b	3.47 a

Mean values having same letter did not differ significantly when tested against DMRT at 5% level of probability

Table-3: Estimation of genetic variability parameters on different traits of the selected cultivar

Traits	Genotypic Variance ($\sigma^2 g$)	Phenotypic Variance ($\sigma^2 p$)	GCV (%)	PCV (%)	Heritability (%)	GA	GA (%)
Plant height (cm)	139.81	132.75	8.014	9.163	76.50	2130.521	1444.117
Tillers/hill	4.05	8.65	11.072	16.186	46.795	283.663	1560.389
Panicle length (cm)	0.71	5.10	3.619	9.680	13.980	65.069	278.7906
Rachillae/panicle	1.6	3.171	10.610	14.624	52.643	193.131	1585.905
Grain number/panicle	155.63	286.03	8.439	11.441	54.411	1895.687	1282.49
Non-filled grain number/panicle	33.62	38.12	28.857	30.727	88.203	1121.868	5583.098
Days to 50% flowering	15.39	25.79	3.559	4.607	59.672	624.339	566.4383
Days to maturity	13.89	23.29	2.749	3.560	59.637	592.966	437.4326
Spikelet length	0.005	0.018	1.182	2.193	29.090	8.114	131.4252
Yield (t/ha)	0.019	0.0223	4.442	4.774	86.567	26.65	851.4376

At genotypic level, non-filled grain number/panicle exhibit more than 20% variation which are regarded as high. Moreover, tillers/hill with rachillae/panicle demonstrate moderate value. Besides this the values of GCV is lower than PCV for all the trait studied. The grater variation between PCV and GCV for the particular trait indicate greater influence of the environment on that trait whereas minor difference shows minimum influence of the environment on that trait. In this experiment, the GCV values were modest than PCV, displaying that the environment had a salient role in the expression of these traits (**Table-3**). More precisely the expression of these traits is mainly due to the genetic constituents rather than environmental influence. Therefore, selection for improvement of these traits might be beneficial. Similar observations were reported for one or more traits [25-27].

Again, heritability values more than 80% are very high, values from 60 to 79% are moderately high, values from 40 to 59% are medium and values less than 40% are low [28]. Among the studied traits the non-filled grain number/panicle and yield (t/ha) showed heritability value above 80% where only plant height (cm) displayed moderately high heritability. Except panicle length (cm) and spikelet length those produced lower heritability rest of the traits elucidate medium heritability (**Table-3**). This revealed that selection would be the best step for choosing rice genotypes having these traits with high to medium heritability. This is due to there would be a close resemblance between the genotypes and the phenotype because of the relative small contribution of the environment to the total variability. Lower heritability of the traits reveals pronounced environmental effect of the expression of those selecting. The maximum genetic advance as percent of mean was in number of non-filled grain/panicle and minimum in Spikelet length (**Table-3**). Genetic advance as a percent mean was estimated minimum as appear from minimum estimate of phenotypic variance and heritability value. Selection based on those traits with a relatively high mean genetic advance will result in the improvement of the performance of the genotypes for that trait. High heritability estimates along with the high genetic advance is usually more useful to predict gain under selection than heritability estimates alone. Being affected by various interrelated traits yield is an important and complex character.

Table-4: Phenotypic correlation (r_p) of different traits of the selected cultivar

	PH	**T/H**	**PL**	**Rn**	**Gn**	**NFGN**	**DF**	**DM**	**SL**	**YIELD**
PH	1	-0.145	0.508**	0.514**	0.526**	0.286	0.487**	0.483	0.156	0.2978
T/H		1	-0.156	-0.282	-0.238	0.093	-0.103	-0.191	-0.220	-0.119
PL			1	0.1826	0.464**	0.244	0.289	0.486**	0.045	0.283
Rn				1	0.361	0.066**	0.128	0.121	0.0281	0.012
Gn					1	0.653**	0.325	0.195	0.272	0.387
NFGN						1	0.263	0.129	0.04999	0.027
DF							1	0.636**	0.344	0.459**
DM								1	0.151	0.377
SL									1	0.586**
YIELD										1

***Significant at 5% level of probability, **Significant at 1% level of probability**

PH=Plant height T/H=Tillers/hill DF=Days to 50% flowering. DM=Days to maturity, Gn=Grain number/panicle, NFGN= Non-filled grain number/panicle, PL=Panicle length, Rn=Racillae/panicle and SL=Spikelet length

[DOI:10.24214/jcbps.B.7.4.115260.]

Therefore, to increase yield planning a protocol might not be effective prior to other yield influencing characteristics directly or indirectly are not taken under consideration. The character association among the selected genotypes is shown in **Table-4**. Plant height displayed highly significant positive correlation with days to 50% flowering, grain no., panicle length and racillae/panicle but non-significant positive correlation with days to maturity, non-filled grain number, and spikelet length but insignificant negative correlation with tillers/hill. Tillers/hill showed negative association with all the traits except non-filled grain number/panicle whish showed insignificant positive correlation. Panicle length showed highly significant positive correlation with days to maturity and grain number, but insignificant positive correlation with rest of the traits. Among the different traits only racillae/panicle showed highly significant positive association with non-filled grain number, where other traits showed positive but insignificant associations. Likewise, racillae/panicle, non-filled grain number, exhibit significant positive association only with grain number/panicle whereas other traits presented insignificant positive associations.

No traits showed significant correlations in relation to non-filled grain number, but all the trait showed positive correlations with non-filled grain number. Days to 50% flowering displayed significant positive correlation with days to maturity and yield but insignificant positive associations with spikelet length. Days to maturity showed positive but insignificant association with spikelet length and yield. Spikelet length significant positive correlation with yield. Positively associated results marked that increment of one trait will result in increment of the associated trait and negative correlated traits states that increase one character will decrease the negatively correlated character. Therefore, selection would be effective for the increment grain yield with simultaneous concerning of days to 50% flowering, spikelet length, days to maturity and grain number. Previous report also stated that days to maturity with spikelet length and panicle length should be given importance for the selection criteria of genetic improvement of rice yield [29].

CONCLUSIONS

The results of various traits studied in this study suggested that some good traits do exist among the selected cultivars. The study result showed there have some significant correlation among the selected traits those can be improved by appropriate selection. The desirable correlated traits can be transferred in the modern cultivar by using suitable breeding techniques for the development of superior cultivar of rice those can play a significant role in meeting the global demand.

REFERENCES

1. K.A. Sanni, D.D. Tia, D.K. Ojo, A.S. Ogunbayo and M. Sikirou. Diversity of rice and related wild species in Africa. Realizing Africa's rice promise CAB International. Wallingford, 2013; 79-87.
2. A. Hamid, N. Uddin, M. Haque and E Haque. *Deshi Dhaner Jat*. Publication no. 59, Bangladesh Rice Research Institute, Gazipur, Bangladesh, 1982, (Bangla).
3. M. Hossain, W.M.H. Jaim, M.S. Alam and A.N.M.M Rahman. Rice biodiversity in Bangladesh: Adoption, diffusion and disappearance of varieties. Dhaka, Bangladesh: BRAC Research and Evalution Division. 2013.
4. BBS (Bangladesh Bureau of Statistics), Statistical Pocket Book of Bangladesh, Government of Peoples Republic of Bangladesh, Dhaka, Bangladesh. 2011.

5. R.K. Singh, U.S. Singh and G.S. Khush. *Aromatic Rices*. Oxford and IBH Publishing, New Delhi, India. 2000.
6. M. Khalequzzaman, M.A. Siddique and M.K. Bashar. “Rice genetic resources conservation and utilization in Bangladesh,” in Proceedings of the National Workshop on Plant Genetic Resources for Nutritional Food Security. BARC, Dhaka, Bangladesh. May 2012, 50-60.
7. M.A.H Sarker. Indigenous fine aromatic rice production: Bangladesh perspective in Development of Basic Standard for Organic Rice Cultivation. RDA (Rural Development Administration) and Dankook University, Yongin, South Korea. 2002, 1-9.
8. S.M. Shahidullah, M.M. Hanafi, M. Ashrafuzzaman, M.R. Ismail and A. Khair. Genetic diversity in grain quality and nutrition of aromatic rice’s. *African Journal of Biotechnology*. 2009, **8** (7): 1238-1246.
9. M.Z. Islam, S. Banik, M.A. Haque, M.A. Siddiquee, M. Khalequzzaman and M.A.K. Mian. Physico-chemical and cooking properties of local aromatic rice germplasm in Bangladesh. *Eco-Friendly Agriculture Journal*. 2013, **6** (10): 243-248.
10. M.A. Baqui, M.E. Ham, D. Jones and R. Straing. The Export Potential of Traditional Varieties of Rice from Bangladesh, Bangladesh Rice Research Institute, Gazipur, Bangladesh. 1997.
11. T. Das. Rices in Bangladesh, Dhanmondi, Dhaka-1205, Bangladesh, India, 2005.
12. B.K. Babu, V. Meena, V. Agarwal and P.K. Agrawal. Population structure and genetic diversity analysis of Indian and exotic rice (*Oryza sativa* L.) accessions using SSR markers. *Molecular Biology Reports*. 2014, **41** (7): 4329-4339.
13. M. Allhgholipour, E. Farshdfar and B. Rabiei. Molecular characterization and genetic diversity analysis of different rice cultivars by microsatellite marker. *Genetika.* 2014, **46** (1): 187-198.
14. V. Pachauri, N. Taneja, P. Vikram, N.K. Singh and S. Singh. Molecular and morphological characterization of Indian farmers rice varieties (*Oryza sativa* L.). *Australian Journal of Crop Science*. 2013, **7** (7): 923-932.
15. C.H. Wang, X.M. Zheng and Q. Xu. Genetic diversity and classification of Oryza sativa with emphasis on Chinese rice garmplasm. *Heredity*. 2014, **112** (5): 489-496.
16. R.K. Varshney, T. Thiel and T. Sretenovic-Rajicic. Identification and validation of a core set of informative genic SSR and SNP markers for assaying functional diversity in barley. *Molecular Breeding*. 2008, **22** (1):1-13.
17. International Rice Genome Sequencing Project. The map based sequence of the rice genome. *Nature*. 2005, **436** (7052): 793-800.
18. A.S. Larik and L.S. Rajput. Estimation of selection indices in *Brassica juncea* L. and *Brassica napus* L. *Pakistan Journal of Botany*. 2000, **32** (2): 323-330.
19. C.D. Cruz, J.E.C. Miranda and C.P Costa. Correlações, efeitos diretos e indiretos de caracteres agronômicos sobre a produção de pimentão (*Capsicum annuum* L.). *Revista Brasileira de Genética*. 1988, **11:** 921-928.

20. J.K. Tiwari and D. Upadhyay. Correlation and path-coefficient studies in tomato (*Lycopersicon esculentum* Mill.). *Research Journal of Agricultural Sci*. 2011, **2**: 63-68.
21. UNDP (United Nations Development Programme), FAO (Food and Agriculture Organization), Land report appraisal of Bangladesh for Agricultural Development report on 2 Agro-ecological regions of Bangladesh. United Nations Development Program and Food and Agriculture Organization. 1988, 212-221.
22. BARC. Bangladesh Agricultural Research Council. Fertilizer Recommendation Guide, 2005, 65.
23. M.F.K. Mishu, M.W. Rahman, M.A.K Azad, B.K. Biswas, M.S.I. Talukder, M.O. Kayess, M.R. Islam and M.R. Alam. Study on Genetic Variability and Character Association of Aromatic Rice (*Oryza sativa* L.) Cultivars. *Interna. J. of Plant & Soil Sci*. 2016, **9** (1): 1-8.
24. M. Tahir, D.R. Khan, A. Zada, A. Khan, D. Wadan, A. Said and K.B. Marwat. Genetic variability of plant and yield characters in rice. *Sarhad J. of Agri*. 2002, **18** (2): 207-210.
25. M.A. Hossain and M.E. Haque. Genetic variability and path analysis in rice genotypes. *Bangladesh Journal of Plant Breeding Genetics*. 2003, **16** (1): 33-37.
26. R.N. Sadhukhan and P. Chattopadhyay. Variability and character association between yields attributes and grain quality in aromatic rice. *J. of Inter acade*. 2000, **4** (4): 494-497.
27. P.S. Biswas, B. Prasad and S.B.A. Dewan. Variability, character association and path analysis of rice (*Oryza sativa* L). *Bangladesh Journal of Plant Breeding and Genetics*. 2000, **13**: 19-25.
28. B.D. Singh. Plant Breeding: Principles and Methods, Kalyani Publishers, New Delhi, India, 2001.
29. V.R. Pandey, P.K. Singh, O.P. Verma and P. Pandey. Inter-relationship and path coefficient estimation in rice under salt stress environment. *International Journal of Agricultural Research*. 2012, **7** (4): 169-184.
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On line publication Date: 15.08.2017