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Genetic variability analysis of different yield contributing characters of cultivated T. Aman rice (*Oryza sativa*) varieties

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ABSTRACT

For any crop establishment research, it is compulsory to evaluate yield related characters with yield to determine the advancement of the subsisting best crop varieties. A field trial was carried out at the Genetics and Plant Breeding research farm at Bangladesh Agricultural University, Mymensingh, to assess yield and yield controlling characteristics for examining their variableness and varietal representation during Aman season. The experiment was disbursed with RCBD design with three replications. Variation due to genotypic coefficient was the maximum for grain yield/plant (53.20) succeeded by 50% flowering expressed in days (43.25), weight of 1000 seed (40.09), maturity expressed in days (33.05), plant height (32.41) and panicle number per plant (32.34). The coefficient of variation due to phenotype was the highest for the unfilled grain's number (85.45) accompanied by grain's yield (64.38), number of panicle per plant (47.49), 50% flowering expressed in days (46.52), weight of 1000 seed (41.31) and plant height (39.89). Maximum heritability was found at weight of 1000 seed (94.16), 50% flowering time (86.02 days), maturity expressed in days (85.68) and plant height (66.02). Considering the character association and variability analysis, filled grain's number, weight of 1000 seed, unfilled grain's number/panicle, panicle/plant and plant height are essential yield components in rice. Emphasis should be given on these characters' select genotypes for next breeding program to enhance yield in transplanted Aman rice.

Key Words: *Genetic advance, Heritability, Genotypic variance and Co-efficient of variance.*

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I. Introduction

Rice (*Oryza sativa* L.) is the world's most widely consumed grain, with over half of the world's population eating it (Kordrostami et al., 2017). Particularly, almost 400 million people of Asia, Africa, and South America are pre-eminently reliant on rice and its evolved products (Surridge, 2004; Joseph et al., 2010). Rice is the second most cultured cereal in the world, after wheat (Abodolereza and Racionzer, 2009). It is the foundation of food protection and is closely linked to Bangladesh's traditional culture and practices. Rice is the main food of Bangladesh's 16 million citizens and the country's total rice cultivation area is nearly 10.83 million hectares, yielding 34.71 million metric tons (Kibria et al., 2017). Rice varieties and landraces may vary due to varied plant type; diversified grain attributes such as size of grain, texture, glutinosity scented and non-scented nature (Islam et al., 2016). Asian and African farmers have selected different types of rice to suit local conditions and needs (Singh et al., 2000). Rice genotypes with satisfactory yield, climate-smart, early with consumer accepted are of utmost need to attain self-sufficiency in rice production (Sing et al., 2008).

The agriculture of Bangladesh is predominantly crop-based and the cropping in this country is dominated by rice cultivation because of its suitable geographical and agro-climatic conditions. It is cultivated in three different seasons of the year and covers about 77% of the total cropped area, approximately 13.9 million hectares (mha). For the time being, rice solely comprises about 92% of the sum grain production of nearly 18.52 million metric tons. Over the period, farmers have identified four specific ecotypes of rice, namely: Aus, Deepwater Aman, Transplant Aman and Boro (Rashid, 1994). Per capita consumption of rice are estimated at 193.4 kg/year. It covers 94% of the cereals consumed in Bangladesh and contributes 69% energy and 54% supplier of protein in the mean ingestion of the people (Rashid, 1994). Rice yield in Bangladesh has significantly increased after the launching of the Green Revolution. The yield of rice, in general, has increased, yet it is much lower than the genetic potential of yield of about 15-16 ton/ha as obtained from the international trials with a Bangladeshi rice variety. However, full genetic potentiality may not be achieved due to various environmental and socio-economic conditions. Yield is a polygenic character and different morpho-physiological attributes take part in grain yield. For accelerating genetic gain, it is pre-requisite to know the variability of different characters.

Genetic heterogeneity must be observed using appropriate parameters such as co-efficient of variation expressed as genotypic (GCV), coefficient of variation expressed as phenotypic (PCV), heritability and genetic advance in order to start a repeatable breeding program and to determine the degree of variability present in landraces and cultivars (Kumar et al., 1998; Mishra et al., 2002; Idris et al., 2012). Yield is controlled by many genes and is governed by other linked traits. Meanwhile, it's critical to comprehend the relationship between other characteristics with yield and genetic variability. Yield controlling traits are correlative and influenced by the environments (Prasad et al., 2001; Chandra et al., 2007; Nayak et al., 2008) and diverged into visible and non-visible influences of associated factors (Mohsin et al., 2009). Efficacy of non-visible selection relies on the extent of correlations between yield and underlying yield components (Toker and Cagirgan, 2004; Bose et al., 2007; Idris et al., 2012; Dhanwani et al., 2013; Pratap et al., 2014). Therefore, the study was set up to determine the variations in genotypes at T. Aman rice varieties for their yield and yield controlling characteristics.

II. Materials and Methods

From July to December 2015, the experiment was conducted at Bangladesh Agricultural University's Genetics and Plant Breeding experimental field laboratory and agricultural farm in Mymensingh. For this analysis, ten different rice varieties were used. Four rice varieties (Binadhan-7, Binadhan-10, Binadhan-11, Binadhan-12) were gathered from the Bangladesh Institute of Nuclear Agriculture (BINA) in Mymensingh and six rice varieties (BRRIdhan51, BRRIdhan52, BRRIdhan55, BRRIdhan56, BRRIdhan62, BRRIdhan64) were gathered from the Bangladesh Rice Research Institute (BRRI) in Gazipur.

The seedbed was created by puddling soil from the field surface to 5-10 cm above it. On the 31st of June, 2015, each of the ten genotypes was grown in a different seedbed. Twenty-five-day-old seedlings, one per hill, were transplanted to the main plot. The plot was 3 meters by 0.75 meters in size. The distances between rows and plants were calculated to be 25 cm and 20 cm, respectively. Different genotypes reach

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maturity at different times. Harvesting was completed when 90 percent of each plot's plant population achieved maturity. For each replication, data for the selected traits were collected on ten randomly chosen plants of each genotype. Time to 50% flowering, maturity (days), plant height (cm), panicle length (cm), panicle/plant, fertile grain/panicle, unfertile grain/panicle, weight of 1000 grain and yield/plant were all considered. The statistical analysis was focused on yield and associated traits data collected from ten rice landraces.

Statistical analysis

Analysis of variance was done for all the characters under study using the mean values (Singh and Choudhury, 1985). Duncan's Multiple Range Test (DMRT) was performed for all the characters to test the difference between the mean of genotypes following Steel and Torrie (1960). Mean, range, co-efficient of variance (CV), phenotypic variance (δ^2p), genotypic variance (δ^2g), Genetic Advance (GA), and Genetic Advance as percent of mean (%GA) was estimated using MSTAT computer program.

Attributes	Definitions	Sources
Genotypic variance	$\delta^2g = \frac{GMS - EMS}{r}$	Johnson et al. (1955)
Phenotypic variance	$\delta^2p = \delta^2g + EMS$	Johnson et al. (1955)
Heritability	$h^2b = \frac{\delta^2 g}{\delta^2 p} \times 100$	Johnson et al. (1955) Hanson et al. (1956)
Genotypic co-efficient of variations	$GCV = \frac{\sigma^2 g}{\overline{X}} \times 100$	Burton (1952) Singh and Chaudhary (1985)
Phenotypic co-efficient of variations	$PCV = \frac{\sigma^2 p}{\overline{X}} \times 100$	Burton (1952) Singh and Chaudhary (1985)
Genetic advance	$GA = h^2b.K.\sigma p$	Johnson et al. (1955) Allard (1960)
Genetic advance in percentage of mean	$GA (\%) = \frac{GA}{\overline{X}} \times 100$	Comstock and Robinson (1952)
	Low (0-10%), moderate (10-20%) and high (≥ 20%)	Johnson et al. (1955) Falconer and Mackay (1996)

Notes: GMS= Genotypic mean square, EMS= Error mean square, r= Number of replication, δ^2g= Genotypic variance, δ^2p= Phenotypic variance, $\overline{X}$ = Population mean, h^2b = Heritability, K= Selection differential, the value of which is 2.06 at 5% selection intensity, GA= Genetic advance

III. Results

Trait- wise mean performance of the genotypes

Study of reorientation of different landraces showed that the genotypes BRRIdhan52 (103.3 days) and Binadhan12 (99.66 days) took longest period for flowering, followed by the genotypes Binadhan7 (80.33 days), Binadhan10 (84.33 days), BRRIdhan51 (98 days), BRRIdhan55 (80.33 days), BRRIdhan56 (79.33 days) and BRRI dhan64 (87.66 days) which were characterized as medium duration variety. The genotype Binadhan11 (72 days) and BRRIdhan62 (71days) required minimum days to 50% flowering (Table 01). Among the genotypes, BRRI dhan62 (103 days) and Binadhan11 (103 days) were the early maturing genotypes. Besides, the genotypes BRRIdhan52 (138.66 days) was late maturing type next to BRRI dhan51 (132 days) followed by Binadhan7 (113.66 days), Binadhan10 (116.33 days), Binadhan12 (130.66 days), BRRI dhan55 (113.33 days), BRRI dhan56 (112.66 days) and BRRI dhan64 (119 days). The genotype Binadhan12 (100.68cm) was the shortest variety similar to Binadhan7 (101.06cm), BRRIdhan51 (102.71cm) and BRRIdhan 62 (108.13cm) and these were significantly different from BRRIdhan56 (136.60cm) but statistically different from Binadhan10 (109.60cm), Binadhan11 (108.24cm), BRRIdhan52 (125.40cm), BRRIdhan55 (108.43cm) and BRRIdhan64 (121.50cm). The genotype Binadhan10 produced the longest panicle (28.197cm). Genotype Binadhan12 produces the shortest type of panicle (24.027cm) which was statistically different from BRRIdhan51 (25.33cm), BRRIdhan52 (27.51cm), BRRIdhan55 (27.58cm), BRRIdhan56 (27.03cm), BRRIdhan62 (27.91cm), BRRIdhan64 (24.21cm), Binadhan7 (24.43cm) and Binadhan11 (27.85cm). The maximum

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panicle/plant was produced by Binadhan10 (14.920), which was statistically different from the second highest genotype BRRIdhan62 (14.367). Genotype Binadhan7 produced the least number of panicle per plant (10.457), which was statistically different from Binadhan11 (11.84), Binadhan12 (12.43), BRRIdhan51 (11.307), BRRIdhan52 (11.27), BRRIdhan55 (11.73), BRRIdhan56 (12.80), BRRIdhan64 (13.297). Genotype BRRIdhan52 contributed the highest fertile grain/panicle (113.753), which was not significantly different from second highest genotype BRRIdhan64 (112.470). These genotypes were statistically different from Binadhan10 (98.187), Binadhan11 (109.593), Binadhan12 (109.317), BRRIdhan51 (109.070), BRRIdhan55 (106.590), BRRIdhan56 (107.923), BRRIdhan62 (96.377). The genotype Binadhan7 produced the lowest number of fertile grain per panicle (91.850). Meanwhile, the genotype with minimum unfilled grain/panicle is expected to be a better yielder. The genotype Binadhan10 produced minimum unfertile grain per panicle (8), which was not significantly diverged from the next lowest BRRIdhan64 (8.333) but the genotype BRRIdhan51 produced highest number of unfilled grain per panicle (14.333). The highest 1000 grain weight (29.133g) was observed in BRRIdhan64, which was statistically different from the second highest BRRIdhan52 (27.520g). Binadhan7 gave the minimum grain weight of 1000 seed (20.197g), significantly different from the second lowest BRRIdhan51 (20.553g). The genotype BRRIdhan62 contributed highest yield/plant (21.543g) and the genotype BRRIdhan55 gave the lowest yield/plant (13.190g), which was statistically diverse from Binadhan10 (17.270g), Binadhan11 (19.133g), Binadhan12 (15.903g), BRRIdhan52 (14.627) BRRIdhan56 (19.160) and BRRIdhan64 (19.517g). Varietal variation is very low in respect of yield due to the narrower gene pool of local germplasm.

Genetic parameter of selected rice genotypes based on different morphological traits:
In this research, genotypic (43.15%) and phenotypic (46.52%) co-efficient of variation were numerically lower for the time of 50% flowering (days) (Table 02). There was a minimum difference between co-efficient of variation due to phenotype and genotype, expressing least interference of environment on these characteristics. Time of 50% flowering (days) expressed maximum heritability (86.02%) and least genetic advance (24.73%) in percent of mean, indicating non-additive genetic control of this character. Maturity expressed in days exhibited genotypic (33.05%) and phenotypic (35.71%) co-efficient of variation. Low distance between genotypic and phenotypic co-efficient of variation was found, which relies that environment had minimum effect on the expression of this character in rice. Maturity expressed in days exhibited greater heritability (85.68%) associated with minimum genetic advance (18.91%) in percent of mean, expressing non-additive gene effects and expression might be influenced largely by non-genetic factors. In the present study, plant height exhibited medium genotypic (32.41%) and phenotypic co-efficient of variation (39.89%). There was a minimal distance between genotypic and phenotypic co-efficient of variation, expressing little contribution of environment in the expression on this attributes. Plant height exhibited medium heritability (66.02%) with medium genetic advance (16.28%) in mean percentage. The results guided the significance of additive and non-additive gene effect on the control of plant height. Genotypic and phenotypic co-efficient of variation were medium for panicle length. There was the least difference between phenotypic (26.71%) and genotypic (18.31%) co-efficient of variation, expressing minor environmental interference on this character. This character exhibited medium heritability (47%) coupled with medium genetic advance (7.76%) in mean percentage. Panicle/plant number exhibited greater genotypic (32.34%) and phenotypic (47.49%) co-efficient of variation. The distance between GCV and PCV expressed great interference of environment in the expression of this trait. This character showed the lowest heritability (46.39%) and greater genetic advance (13.61%) in mean percentage, expressing the availability of additive gene effects that can be revealed serially in segregating generation's efficiency in a breeding population. Filled grain/panicle exhibited medium genotypic (21.93%) and phenotypic (25.91%) co-efficient of variation. The distance between GCV and PCV expressed considerable interference of environment in the character expression. These traits also exhibited maximum heritability (71.61%) with medium genetic advance (11.47%) in percent of mean, indicating the existence of additive gene effects that can be overlapped continuously in segregating generations, leading to greater ability in the breeding population. The genotypic and phenotypic co-efficient of variation was maximum for this trait. The phenotypic co-efficient of variation (85.45%) was maximum than genotypic (34.38%) co-efficient of variation in case of unfilled grain/panicle, illustrating that this trait was slightly controlled by environment. The heritability calculation expressed that unfilled grain/ panicle had least heritability (16.18%) coupled with minimum genetic advance (8.55%) in mean percentage. This character might be extensively heritable and undesirable in selection program for yield

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enhancement. Grain weight of 1000 seeds showed moderate genotypic (40.09%) and phenotypic (41.31%) co-efficient of variation. The phenotypic co-efficiency of variation was maximum than the genotypic coefficient of variation expressing regard able environmental interference on 1000 grain weight of seed. Maximum genetic advance (24.04%) in case of in mean percentage linked with greater heritability (94.16%) were found for grain weight of 1000 seeds, expressing non-additive gene influence and evolution can be controlled extensively by non-genetic factors. Character namely yield exhibited a maximum genotypic (53.20%) and phenotypic (64.38%) co-efficient of variation. The phenotypic co-efficiency of variation was greater than the genotypic coefficient of variation, expressing expected environmental influence on yield per plant. This character expressed greater heritability (68.29%) and high genetic advance (27.17%) in percent of mean, expressing the existence of additive with non-additive genes interference.

Table 01. Mean performance of 10 rice genotypes based on diverse morphological characters linked to yield

Genotypes	Days to 50% flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	Number of panicle plant^{-1}	Number of filled grains panicle^{-1}	Number of unfilled grains panicle^{-1}	1000 seed weight (g)	Grain yield plant^{-1} (g)
Binadhan7	80.33 ab	113.66 ab	101.06 b	24.43 ab	10.457c	91.85 b	12.33 ab	20.19 c	20.86 ab
Binadhan10	84.33 ab	116.33 ab	109.60 ab	28.19 a	14.920 a	98.18 ab	8.00 b	26.57abc	17.27 abc
Binadhan11	72.00 b	103.00 b	108.24 ab	27.85 ab	11.843 abc	109.59 ab	12.66 ab	24.21 abc	19.13 abc
Binadhan12	99.66 a	130.66 ab	100.68 b	24.02 b	12.420 abc	109.31 ab	12.66 ab	22.72 abc	15.90 abc
BRRIdhan51	98.00 ab	132.00 a	102.71 b	25.33 ab	11.307 bc	109.07 ab	14.33 a	20.55 bc	13.70 bc
BRRIdhan52	103.3 a	138.66 a	125.40 ab	27.51 ab	11.273 bc	113.75 a	12.00 ab	27.52 ab	14.62 abc
BRRIdhan55	80.33 ab	113.33 ab	108.43 ab	27.58 ab	11.730 abc	106.59 ab	12.33 ab	22.34 abc	13.19 c
BRRIdhan56	79.33 ab	112.66 ab	136.60 a	27.03 ab	12.803 abc	107.92 ab	11.33 ab	25.88 abc	19.16 abc
BRRIdhan62	71.00 b	103.00 b	108.13 b	27.91 ab	14.367 ab	96.37 ab	11.33 ab	24.09 abc	21.54 a
BRRIdhan64	87.66 ab	119.00 ab	121.50 ab	24.21 ab	13.297 abc	112.47a	8.333 b	29.13 a	19.51abc
$LSD_{(0.05)}$	27.335	28.942	28.383	4.089	3.414	17.745	4.719	7.101	7.208
SE (±)	2.21	2.31	2.44	0.376	0.326	8	3.014	2.911	3.306
SD	12.12	12.65	13.38	2.058	1.785	116.62	18	29.55	22.83
CV (%)	14.16	10.7	11.92	7.79	14.34	1.46	0.55	0.532	0.604

Table 02. Conjecture of genetic parameter of selected rice genotypes relies on diverged morphological characteristics linked to yield

Characters	Phenotypic variance (δ^2p)	Genotypic variance (δ^2g)	Grand mean	PCV (%)	GCV (%)	Heritability (%)	GA	GA (%)
Days to 50% flowering	142.73	122.77	85.60	46.52	43.15	86.02	21.17	24.73
Days to maturity	160.40	137.43	118.23	35.71	33.05	85.68	22.35	18.91
Plant height (cm)	180.40	119.11	112.24	39.89	32.41	66.02	18.27	16.28
Panicle length (cm)	4.48	2.11	26.41	26.71	18.31	47.00	2.05	7.76
Number of panicle plant^{-1}	3.14	1.46	12.44	47.49	32.34	46.39	1.69	13.61
Number of filled grains panicle^{-1}	67.27	48.17	105.51	25.91	21.93	71.61	12.10	11.47
Number of unfilled grains panicle^{-1}	8.74	1.41	11.53	85.45	34.38	16.18	0.99	8.55
1000 seed weight(g)	9.09	8.56	24.32	41.31	40.09	94.16	5.85	24.04
Grain yield plant^{-1} (g)	11.41	7.79	17.49	64.38	53.20	68.29	4.75	27.17

Here, GCV= Genotypic Co-efficient of Variance; PCV= Phenotypic Co-efficient of Variance; GA= Genetic Advance; GA (%)= Genetic Advance as mean percentage.

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IV. Discussion

For 50 percent flowering expressed in days, variation due to genotypic and phenotypic co-efficient was minimal in this analysis (Table 02). The gap between genotypic and phenotypic co-efficient of variance was the shortest, indicating that the environment had the least impact on this character. The least value of GCV and PCV with minimum distance was also found by Kaw et al. (1999) for 50% flowering expressed in days for rice. A very minimum GCV with lowest distance with PCV was also found by Das et al. (1992). 50% flowering expressed in days exhibited greater heritability and minimum genetic advance in percent of mean, expressing non-additive genetic influence of this trait. Gupta et al. (1999) found maximum heritability with least genetic advance for flowering expressed in days for rice. Sing et al. (1985) also revealed that maximum heritability (95.1%) with less genetic advance (14.7%) in mean percentage in his research. Distance between genotypic and phenotypic co-efficient of variation in days to maturity was meager, which underlying that environment had less interference on the character expression in rice. Shaha et al. (1993a) got least genotypic (2.53%) and phenotypic (2.62%) co-efficient of variation with minimum difference. Das et al. (1992) also got the least distance between GCV and PCV for maturity expressed in days. Maturity expressed in days exhibited greater heritability along with least genetic advance in percent of mean, expressing non-additive gene influence and expression can be partitioned greatly by non-genetic factors. Debi et al. (1997) expressed that maximum heritability and least genetic advance in percent of mean for maturity in rice. Rao and Shrivastava (1994) also expressed high heritability for this character. In this study, plant height exhibited average genotypic and phenotypic co-efficient of variation. There was a minimum distance between genotypic and phenotypic co-efficient of variation, indicating less interference of environment in the expression on this trait. Maurya et al. (1986) expressed that medium genotypic and phenotypic co-efficient of variation and expressed low interference of the environment on this trait. Medium genotypic (16.6%) and phenotypic co-efficient of variation (16.85%) with almost no difference was reported by Wilpeed et al. (1993). Plant height expressed medium heritability coupled with medium genetic advance in mean percentage. The results triggered the significance of additive and non-additive gene influence on the control of plant height. Kumar et al. (1994) expressed high heritability coupled with moderate genetic advance for plant height. Maurya et al. (1986) also found such a high heritability and medium genetic advance for this trait.

For panicle length, the genotypic and phenotypic co-efficient of variation were both medium. The phenotypic and genotypic co-efficient of variance were the closest, showing the least amount of environmental interference on this trait. Biswas et al. (2000) cited that panicle length exhibited medium genotypic co-efficient of variation and phenotypic co-efficient of variation. Chakraborty and Hazaiika (1994) expressed a minimal distance between phenotypic and genotypic co-efficient of variation in panicle length. This character exhibited medium heritability (47%) along with medium genetic advance in mean percentage. The results indicate that the significance of additive and non-additive gene effects on the control of panicle length. Chakraborty and Hazarika (1994) found maximum heritability and medium genetic advance for panicle length. Kumari et al. (2003) evaluated 55 rice cultivars and their 42 crosses and found maximum heritability and medium genetic advance for this trait. In this study, number of panicles per plant expressed high genotypic and phenotypic co-efficient of variation. The distance between GCV and PCV expressed a considerable impact on environment in the expression of this character. Singh and Choudhury (1996) found higher PCV and GCV and suggested that the environmental effect attributed more to phenotypic co-efficiency variation. These characteristics showed least heritability coupled with maximum genetic advance in mean percentage, expressing the existence of additive gene effects expressed continuously in segregating populations, leading to higher efficacy of a breeding population. Gupta et al. (1999) found low heritability coupled with greater genetic advance implying additive gene action. Chookar et al. (1994) found lowest heritability with high genetic advance expressing additive gene action that gives the best selection preference. Kumari et al. (2003) examined 55 rice cultivars and their 42 crosses and found low heritability coupled with high genetic advance for this trait in rice. Filled grain/panicle exhibited average genotypic and phenotypic co-efficient of variation. The distance between GCV and PCV showed great interference of environment in the expression of this trait. Shaha et al. (1993b) revealed medium genotypic (26.14%) and phenotypic (27.85%) co-efficient of variation for filled grain/ panicle. Singh et al. (1985) also expressed maximum GCV (30.7%) and PCV (37.5%) for these attributes in rice. Maurya. (1994) revealed maximum heritability with medium genetic advance for mean percentage in filled grain/panicle. A close result was also found by Paramasivan and Rangasamy (1988). The phenotypic co-efficiency of variation was

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greater than the genotypic coefficient of variation, expressing that this character was minimal influenced by the environment. Ahmed and Das (1994) also got such environmental interference on this trait. Babu (1996) found a greater genotypic and phenotypic coefficient of variation for this trait in rice. Paul and Sarmah (1998) found less genotypic co-efficient of variation, minimal heritability and maximum genetic advance for unfilled grain/panicle. The weight of thousands was of medium genotypic and phenotypic variation coefficient. When expressing constant environmental interference on grain weight of 1000 seed, the phenotypic co-efficiency of variation was greater than the genotypic co-efficiency of variation. Sawant et al. (1994) found a significant difference between high genotypic and phenotypic co-efficient of variation for 1000 grain weight. Similar trends were also found by Kumar et al. (1998). Low genetic advance mean percentage linked with medium heritability was found for grain weight of 1000 seed, expressing non-additive gene effects and non-genetic factors largely govern that. Kumari et al. (2003) found that this trait has a medium heritability and a medium genetic advance, emphasizing the role of non-additive gene influence in its inheritance. The maximum genotypic and phenotypic coefficient of variation was shown per plant yield. The phenotypic variation coefficient was higher than the genotypic variation coefficient, expressing maximum environmental effects on plant yield. Sawant and Patil (1995) found high genotypic and phenotypic co-efficient of variation for this trait. Similar trends were also reported by Li et al. (1991) and Das et al. (1992). This character expressed maximum heritability and greater genetic advance in mean percentage, expressing both additive and non-additive genes on maintaining this character. Vishwakarma et al. (1989) found that broad sense heritability was medium and maximum genetic advance for yield per plant. Li et al. (1991) also got a similar result. The same amount of heritability and genetic advance were found for yield per plant in rice by Yadav (2000).

V. Conclusion

It was found that all the traits exhibited high heritability except unfilled grains number/panicle. Calculation of genetic advance in mean percentage was maximum for the characters, 50% flowering expressed in days, maturity expressed in days, seed weight of 1000 seed, and yield. Plant height, panicle number/plant and filled grain/panicle exhibited medium and panicle length and unfilled grain/panicle exhibited low genetic advance in mean percentage. Greater heritability and maximum genetic advance in mean percentage were found for 50% flowering expressed in days, maturity expressed in days, plant height, seed weight of 1000 seed and yield. As a result, these characteristics will be suitable for selection. Selection of the above-mentioned traits based on our findings could be used in future breeding programs to produce high-yielding, short-duration rice varieties.

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