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Evaluation of Yield and Yield Attributing Traits in Advanced Breeding Lines of Rice (*Oryza sativa* L.) over Two Rice Growing Seasons in Guyana.

Mahendra Persaud[1*], Danata McGowan[1], Nandram Gobind[1], Rajendra Persaud[1], Edgar Corredor[2]

[1,] Guyana Rice Development Board, Rice Research Station, Burma, Mahaicony, East Coast Demerara, Guyana
[2,] Fund for Latin America Rice/Central Institute for Tropical Agriculture, Cali, Colombia

Email addresses: mahendra21@gmail.com (Mahendra Persaud), danatamcgowan@yahoo.com (Danata McGowan), nandram.gobind@gmail.com (Nandram Gobind) rpersaud@grdb.gy (Rajendra Persaud) e.corredor@cgiar.org (Edgar Corredor)

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****Corresponding Author***
Mahendra Persaud
E-mail: *mahendra21@gmail.com*

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ABSTRACT

Rice has grown to be the most economically important food crop in numerous countries due to food diversification. The increase in rice productivity has become fundamental in order to meet the world's current population growth rate. However, as the availability of arable land continues to decline it is crucial to increase crop yield through the development of high yielding varieties. In the present study fifteen advanced breeding lines of rice (FG12-23, FG12-49, FG12-259, G14-10, G15-02, G15-11, FG15-01, FG15-02, G16-102, G16-104, G16-108, G16-112, FG14-43, FG15-35, G13-126) were evaluated in a randomized complete block design with three replicates in the background of commercial varieties GRDB FL 10, GRDB FL 12 and GRDB FL 14 for their yield and yield attributing traits. The trial was conducted at Black Bush Polder, Region 6 during the first and second crop/season of 2018 in Guyana. Mean values for quantitative traits viz. plant height, productive tillers/m2, lodging %, grain yield, panicle length, filled and unfilled grains per panicle, spikelet fertility and 1000 grain weight were compared according to least significant differences (LSD) statistical test. All traits examined showed some degree of significant variability. Line FG12-259 recorded the most tillers/m2 (338) as well as the highest grain yield (7276.6 Kg/ha) over the two seasons. With regards to filled and unfilled grains per panicle, lines G16-108 and G16-104 both recorded 168 filled grains per panicle which was significantly higher than the other tested lines while G16-104 also recorded the most unfilled grains per panicle (45). GRDB 10 was observed to have the highest spikelet fertility (90.7%) while G15-02 attained the lowest (73.5%). Panicle length ranged from 21.67cm in G16-108 to 29.56cm in GRDB 12 while maximum 1000 grain weight was 30.75g (G15-02) and the minimum 22.53g (G16-108). The plant height of the tested lines ranged from semi-dwarf to intermediate averaging 108.7cm. Relatively low incidence of lodging was observed (<12%) as only four of the tested lines G15-11, FG15-01, GRDB 10 and GRDB 12 showed signs of lodging. FG12-259 was recommended for further evaluation in farmers' fields.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important food crop and energy source for about half of the world's population and ranks second in production after wheat (Udayand Hittalmani, 2014). Rice occupies a unique position in many nations because of its importance in traditional diets and being the main source of income for many people across the world.

Today, increasing rice production has become a major goal because the world population is growing very rapidly. An additional two billion persons will have to be fed around mid-century, that is when the world reaches the 9 billion mark, and this is projected to exceed 10 billion by the end of the century. If global per capita rice consumption follows the trend of the past two decades, then total consumption will grow at the rate of population growth (Mohanty, 2013). Moreover, growing population could also shrink rice acreage in future, worsening global food security.

The increase of rice yield therefore will have to be met through an increase in productivity per unit land. The main contributory factor for increasing rice production is the high yielding rice varieties. Plant breeding is one way to confront the challenge of bridging the widening gap between the demand and supply of food. In rice breeding, the most important qualities sought by breeders have been high yield potential, resistance to major diseases and insects, and improved grain and eating quality [9]. Growth and yield of rice are strongly influenced by genotype as well as environmental factors. The genetic potential of a rice variety is almost fixed and it determines the limit of productivity, but grain yield can be increased by the manipulation of management practices and by growing in recommended season (BRRI, 1999).

In Guyana rice is considered the most important food crop, it is grown during two seasons known as "*spring crop*" which extends from November to April and "*autumn crop*" which extends from May to October. Increasing productivity of rice in Guyana through genetic manipulation is an important approach to improve the competitiveness of rice industry in the face of the changing environment in which rice has to grow, pest and the diseases complex that prevails and serious threat from major rice export countries of the world. An organized breeding program was conceived by the Plant Breeding Department of the Guyana Rice Development Board (GRDB), Rice Research Station to satisfy the needs of rice farmers through several major objectives which includes; increasing the yield potential of local varieties. In keeping with the above mentioned points the objective of this study is to evaluate fifteen Advanced Breeding Lines with the aim of selecting those that have good yield and yield contributing traits for further evaluation and possible release as commercial varieties.

2. MATERIALS AND METHOD

The current investigation was carried out at the Sub-Station of the GRDB located in Black Bush Polder, Berbice, for two successive seasons in 2018. Fifteen advanced breeding lines were tested against commercial varieties (GRDB FL 10, GRDB FL 12 and GRDB FL 14). The experiment was set up in a Randomised Complete Block Design (RCBD) with three replicates. Genotypes were sown in 24 m^2 plots at a seed rate of 157.2 kg/ha. Fertilizer was applied at a rate of 100 kg N/ha + 30 kg P_2O5 ha^{-1} + 40 kg K_2O/ha and routine husbandry practices were followed throughout the trial. The variables observed were; plant height, productive tiller/m, percentage lodging, grain yield (Kg/ha), panicle length, filled grains per panicle, unfilled grains per panicle, spikelet fertility and 1000 grain weight. The variance of data was analysed using analysis of variance (ANOVA) with Statistix 8 software, and mean values for traits were compared according to Least Significant Difference (LSD) statistical test.

3. RESULTS

Table 1. *Means for 1000 grain weight, panicle length, filled and unfilled grains and fertility % of advanced lines of rice for two seasons.*

	Spring Crop					Autumn Crop				
Strain	**Panicle Length (cm)**	**Filled grains/ panicle**	**Unfilled grains/ panicle**	**Fertility (%)**	**1000-Grain Weight (g)**	**Panicle Length (cm)**	**Filled Grains/panicle**	**Unfilled Grains/ panicle**	**Fertility (%)**	**1000-Grain Weight (g)**
FG12-23	24.34 cdef	127 de	10 c	92.7 a	29.03 bcde	23.26 bc	97 c	22 de	82.2 abc	26.00 bcd
FG12-49	24.08 def	171 abc	20 bc	89.5 ab	26.6 ef	23.74 bc	149 ab	53 ab	73.6 cde	22.33 f
FG12-259	25.56 abcde	146 bcde	12 c	92.0 a	26.67 def	26.29 abc	114 abc	37 bcd	75.3 bcd	25.73 bcd
G14-10	26.55 abc	136 bcde	17 bc	89.5 ab	30.4 c	28.31 ab	163 a	24 de	87..3 a	25.23 cde
G15-02	22.38 f	118 e	32 ab	82.8 b	33.27 a	23.41 bc	118 abc	64 a	65.1 e	28.23 a
G15-11	23.53 ef	154 abcde	10 c	93.7 a	29.17 bcde	24.01 bc	123 abc	27 de	82.7 ab	26.30 abc
FG15-01	26.72 ab	125 de	20 bc	86.3 ab	30.53 abc	26.31 abc	100 bc	30 cde	77.4 bcd	27.83 ab
FG15-02	23.47 ef	118 abcde	7 c	94.2 a	31.13 ab	24.68 bc	118 abc	28 de	81.0 abcd	26.43 abc
G16-102	25.51 abcde	141 bcde	12 c	92.4 a	28.43 bcde	25.46 bc	114 abc	32 cde	78.1 bcd	26.20 abcd
G16-104	25.81 abcde	187 a	42 a	93.1 a	29.5 bcd	25.43 bc	149 ab	47 abc	76.1 bcd	27.10 abc
G16-108	22.01 f	173 ab	15 b c	92.1 a	25.13 f	21.20 c	162 a	30 cde	83.3 ab	19.93 g
G16-112	24.34 cdef	129 de	12 c	91.6 a	29.97 bc	25.23 bc	118 abc	61 a	65.4 e	25.73 bcd
FG14-43	26.29 abcd	126 de	11 c	92 a	28.53 bcde	26.19 abc	126 abc	32 cde	80.3 abcd	26.30 abc
FG15-35	25.21 bcde	126 de	10 c	92.8 a	30.4 bc	25.81 abc	103 bc	36 bcd	73.3 de	25.63 cd
G13-126	25.19 bcde	131 de	11 c	92.3 a	28.17 cde	24.88 bc	133 abc	29 cde	82.3 abc	24.07 def
GRDBFL 10	25.08 bcde	133 cde	9 c	93.7 a	28.73 bcde	26.22 abc	107 bc	15 e	87.6 a	26.73 abc
GRDBFL 12	27.62 a	161 abcd	14 c	92.3 a	30.47 abc	31.49 a	97 c	31 cde	75.7 bcd	25.80 bcd
GRDBFL 14	25.3 abcde	127 de	9 c	93.1 a	27.77 cdef	25.48 bc	141 abc	29 cde	82.8 ab	23.43 ef
Grand Mean	24.94	142	15	90.781	29.11	25.41	124	35	78.307	25.5
CV	5.72	16.59	72.46	5.52	5.89	14.03	24.73	32.06	6.79	5.09
P value	0.0018			0.1384	0.0006	0.3805			0.0002	0.0000

Mean sharing same letter in a column are not significantly different at 0.05% probability level using LSD.

Panicle length

The mean values for panicle length of eighteen rice genotype ranged from 22.01cm to 27.62cm during the spring crop of 2018. The commercial variety GRDB FL 12 was observed to have the longest panicle, with the highest mean value of 27.62cm, followed by the strain FG15-01 with an average length of 26.72cm which was determined to be significantly different from the former. The strains with the shortest panicle length recorded were G15-02 (22.38cm) and G16-108 (22.01cm). Similar results were obtained during the autumn crop as the commercial variety GRDB FL 12 again recorded the longest panicles (31.49cm) while G16-108 recorded the shortest panicles with mean length of 21.20cm (Table 1).

Filled grains

During the spring crop the highest number of filled grains per panicle was observed from strain G16-104 (187 grains). Strains G16-108 (173 grains), FG12-19 (171 grains), FG 15-02 (154 grains) and Check GRDB FL 12 (161 grains) were statistically similar to that of FG16-104. Strain G15-02 recorded the least amount of filled grains per panicle (118 grains). However during the autumn crop strain G14-10 recorded the largest number of filled grains per panicle (163 grains) and commercial variety GRDB 12 the least (97 grains), (Table 1).

Unfilled grains

Along with having the largest number of filled grains per panicle during the spring crop of 2018 G16-104 also recorded the largest number of unfilled grains per panicle for that season (42 grains), this was followed by G15-02 with 32 unfilled grains per panicle. Unfilled grains per panicle were generally greater during the autumn crop as lines G15-02 and G16-112 yielded 64 and 61 unfilled grains per panicle respectively which was significantly higher than other lines (Table 1).

Spikelet Fertility

The fertility percent of evaluated lined ranged from 93.7% in GRDB FL 10 and G 15-11 to 82.8% in G15-02 during the first season of evaluation, similar data was recorded during the second season as GRDB 10 again recorded significantly higher percentage of spikelet fertility as compared to other entries while G15-02 recorded the lowest spikelet fertility (65.1%) in this season.

Grain weight

The weight of 1000 grains was determined and during both seasons; G15-02 was found to have heavier grains (33.27g spring, 28.23g autumn) compared to other evaluated strains, while the grains of G16-108 were found to weigh the least (25.13g) during the spring and FG12-49 (22.33g) during the autumn season (Table 1).

Table 2. *Means for plant height, tiller, lodging % and grain yield of advanced lines of rice for two seasons.*

	1st Season				**2nd Season**			
Strain	**Plant Height(cm)**	**Productive tiller/m²**	**Lodging %**	**Yield (Kg/ha)**	**Plant Height(cm)**	**Productive tiller/m²**	**Lodging %**	**Yield (Kg/ha)**
FG12-23	111.6 abcd	267 cde	0 b	8894 abc	108.87 bcdef	270 bc	0 b	3915.1 ab
FG12-49	100.73 ef	234 de	0 b	10112 ab	99.9 g	237 c	0 b	3763.1 abc
FG12-259	108.17 cd	336 ab	0 b	10153 ab	110.07 abcdef	339 a	0 b	4400.2 a
G14-10	115.2 ab	280 bcde	0 b	8894 abc	110.83 abcde	245 c	0 b	3422.3 bcde
G15-02	113.37 abc	229 e	0 b	8163 cd	112.6 ab	329 ab	0 b	2839.1 cde
G15-11	110.47 bcd	256 cde	23.33 a	8186 cd	107.63 cdef	279 abc	0 b	3513.0 abcde
FG15-01	110.23 bcd	245 cde	3.33 b	7598 cd	114.8 a	247 c	0 b	2942.0 cde
FG15-02	105.63 de	307 abc	0 b	9219 abc	109.33 bcdef	329 ab	0 b	2575.5 e
G16-102	106.37 de	297 abcd	0 b	8283 cd	106.63 cdef	285 abc	0 b	2803.8 de
G16-104	108.13 cd	242 cde	0 b	9008 abc	111.03 abcd	297 abc	0 b	3356.0 bcde
G16-108	107.2 d	249 cde	0 b	7999 cd	109.83 bcdef	273 bc	0 b	3254.5 bcde
G16-112	117.1 a	307 abc	0 b	6706 d	111.07 abcd	246 c	0 b	2941.2 cde
FG14-43	105.67 de	280 bcde	0 b	9276 abc	106.37 def	297 abc	0 b	3970.2 ab
FG15-35	108.47 cd	290 abcde	0 b	9049 abc	107.73 cdef	236 c	0 b	3303.9 bcde
G13-126	109.23 bcd	245 cde	0 b	8787 abc	111.23 abc	281 abc	0 b	4187.8 ab
GRDB 10	97.73 f	353 a	0 b	8619 bc	105.5 f	249 c	3.33 a	4024.5 ab
GRDB 12	110.93bcd	346 ab	3.33 b	10418 a	106.07 ef	265 bc	0 b	2904.5 cde
GRDB 14	106.03 de	293 abcde	0 b	8523b c	111.27 abc	244 c	0 b	3535.6 abcd
Grand Mean	108.46	281	1.67	8771.6	108.93	271	0.185	3425.1
CV	3.38	14.51	235.15	11.86	2.65	14.41	734.85	16.68
P value	0.0000	0.0070	0.0000	0.0168	0.0003	0.0794	0.4813	0.0088

Mean sharing same letter in a column are not significantly different at 0.05% probability level using LSD.

Plant height

With respect to plant height, this varied among the tested lines, ranging from 97.73cm (GRDB 10) to 117.19cm (G16-112) in the spring season and from 105.5cm (GRDB 10) to 114.8cm (FG15-01) during the autumn season (Table 2).

Tiller count

A count of the number of tillers produced per m^2 by each line was made and the commercial variety GRDB 10 was observed to produce the highest number of tillers during the spring season (353) followed by GRDB 12 (346) and FG12-249 (336). GRDB 10 however produced among the lowest number of tillers during the autumn season (249) while FG12-259 produced a significantly larger number of tillers (339) as compared to others followed by G15-02 and FG15-02 both producing 329 tillers each (Table 2).

Percentage lodging

There was an exceptionally low incidence of lodging across both seasons. Strains which showed signs of lodging were G15-11 (23.33%), FG15-01 (3.33%) and GRDB 12 (3.33%) during the spring season and GRDB 10 (3.33%) during the autumn season (Table 2). Strain G15-11 and GRDB 12 showed significantly higher lodging tendency for the first and second crop respectively, compared to all the other strains tested.

Grain yield

The strain producing the highest yield during the spring season was the commercial variety GRDB 12 (10,418 Kg/ha). Nine other genotypes *viz.*, FG12-23, FG12-49, FG12-259, G14-10, G14-10, G16-04, FG14-43, FG15-35, and G13-126 yield statistically similar to that of GRDB12. Yields obtained for the autumn season was generally lower that of the spring season, however, the significant highest yielding strain during the autumn season was FG12-259 with 4400.2 Kg/ha. Seven genotypes (FG12-23, FG12-49, G15-11, FG14-43, G13-126, GRDB 10, and GRDB 14) showed statistically similar grain yields compared the FG12-259, while FG 15-02 produced the lowest yield of 2575.5 Kg/ha (Table 2).

Table 3. *Means for average grain yield and yield attributing traits for the year 2018.*

Variety	Panicle length(cm)	Filled grains/ panicle	Unfilled grains/ panicle	Fertility (%)	1000 Grain weight (g)	Plant Height(cm)	Productive tiller/m^2	Lodging (%)	Yield (Kg/ha)
FG12-23	23.80 ghi	112 d	16 c	87.5 ab	27.52 bcde	110.23 abcd	269 abc	0.00 b	6404.6 abcd
FG12-49	23.91 fghi	160 ab	37 ab	81.6 bcd	24.47 fg	100.32 f	236 c	0.00 b	6937.6 ab
FG12-259	25.93 bcd	130 bcd	25 bc	83.7 bcd	26.20 cdef	109.12 bcde	338 a	0.00 b	7276.6 a
G14-10	27.43 b	149 abc	21 bc	87.9 ab	27.82 bcd	113.02 ab	263 abc	0.00 b	6158.1 abcd
G15-02	22.90 ij	118 cd	48 a	73.5 e	30.75 a	112.98 ab	279 abc	0.00 b	5501.1 cde
G15-11	23.77 hi	138 abcd	19 c	88.2 ab	27.74 bcd	109.05 cde	268 abc	11.67 a	5849.5 bcde
FG15-01	26.52 bc	113 d	25 bc	81.8 bcd	29.18 ab	112.52 abc	246 bc	1.67 b	5270.0 de
FG15-02	24.08 efghi	118 cd	18 c	87.6 ab	28.78 b	107.48 de	318 ab	0.00 b	5897.3 bcde
G16-102	25.49 cdefg	127 cd	22 bc	85.2 abc	27.32 bcde	106.50 de	291 abc	0.00 b	5543.4 cde
G16-104	25.62 cde	168 a	45 a	79.6 cde	28.30 b	109.58 bcde	270 abc	0.00 b	6182.0 abcd
G16-108	21.61 j	168 a	22 bc	87.7 ab	22.53 g	108.52 de	261 bc	0.00 b	5626.8 cde
G16-112	24.79 defgh	123 cd	37 ab	78.5 de	27.85 bcd	114.08 a	277 abc	0.00 b	4823.6 e
FG14-43	26.24 bcd	126 cd	21 bc	86.1 abc	27.42 bcde	106.02 e	289 abc	0.00 b	6623.1 abc
FG15-35	25.51 cdef	115 d	23 bc	83.0 bcd	28.02 bcd	108.10 de	263 abc	0.00 b	6176.4 abcd
G13-126	25.04 cdefgh	132 bcd	20 c	87.3 ab	26.12 def	110.23 abcd	263 abc	0.00 b	6487.4 abcd
GRDB FL 10	25.65 cde	120 cd	12 c	90.7 a	27.73 bcd	101.62 f	301 abc	1.67 b	6321.8 abcd
GRDB FL 12	29.56 a	129 bcd	22 bc	84.0 abcd	28.14 bc	108.50 de	306 abc	1.67 b	6661.3 abc
GRDB FL 14	25.39 cdefgh	134 bcd	19 c	87.9 ab	25.60 ef	108.65 cde	269 abc	0.00 b	6029.3 abcde
Grand Mean	25.177	132	25	84.556	27.303	108.7	278	0.9259	6098.3
CV	3.21	11.40	30.98	4.79	3.38	2.17	12.85	228.24	10.15
P value	0.0000			0.0012	0.7589	0.0000	0.4971	0.0000	0.0917

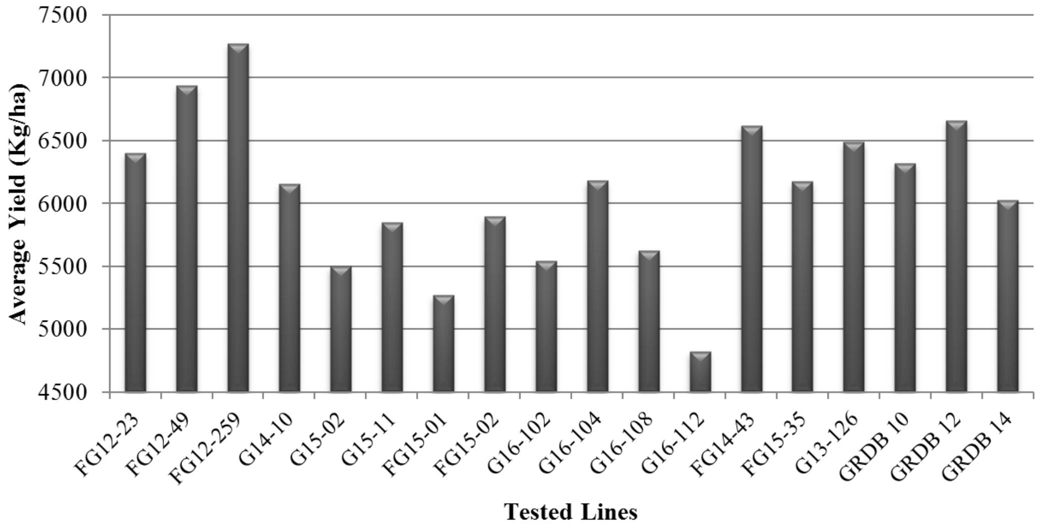

Figure 1. *Average Grain Yield of Advanced Breeding Lines – 2018.*

4. DISCUSSION

This study was able to examine the influence few agronomic characters have on the yield performance of fifteen rice genotypes. This research did not however attempt to correlation analysis to determine whether the agronomic characters and yield components had a positive or negative correlation to the yield. Since grain yield is considered a polygenic character greatly influenced by environmental factors it is important to directly identify the source having the greatest impact on grain yield as some rice genotype may be more severely affected by environmental conditions than others.

Panicle length is an essential yield attributing quality, an overall examination of the average panicle length of tested lines revealed statistically significant differences among them. Commercial variety GRDB FL 12 had an average panicle length of 29.56 cm which was significantly the longest recorded in this study. Strains FG12-259, G14-10, and FG15-01were showed significantly longer panicle compared all the other strains tested, except check variety GRDB FL 12, while G16-108 was statistically the shortest (Table 3). Rice plants with long panicles potentially have a high number of grain total and high yield because there is a positive correlation between panicle length and the number of grains per panicle, (Haryanto et al., 2008). However, during this study shorter panicles were observed to have significantly larger number of grains as compared to others. G16-108 produced the shortest panicles when evaluated but along with G16-104 recorded the largest number of filled grains per panicle (168 grains), G16-104 also recorded a significantly larger number of unfilled grains per panicle (45 grains) as compared to other lines (Table 3). It is therefore important to note that though there may be a positive correlation between panicle length and number of grains per panicle as stated in previous studies it is also possible that genetic traits can contribute to shorter panicles being more compact and of higher fertility thereby having a higher yield than that of its longer counterparts.

The check variety GRDB 10 recorded the highest fertility percent (90.7) across both seasons, thus indicating that while this line may not have attained significantly larger amount of grains per panicle the ratio of filled to unfilled grains was greater than of all other tested entries. The difference between the number of grains per panicle and number of unfilled grains per panicle is thought to be caused by the genetic influence of each line, environmental factors however may also play a role in influencing these characters. Strains FG12-23, G14-10, G15-11, FG15-02, G16-102, FG14-43, G13-126, and checks GRDB FL 12 and GRDB FL 14 showed statistically similar fertility levels to that of GRDB FL 10.

With respect to 1000 grain weight, the line G15-02 produced the heaviest grains with an overall average of 30.75g which was significantly greater than those produced by other tested lines (Table 3), but similar to that of FG15-01. Grain weight is an important yield contributing trait which is govern by genetic factors and is highly heritable (Ma et al. 2006). Therefore strains G15-02 and FG15-01can be identified as parent to improve the yield potential of local varieties.

The average plant height of tested lines ranged from 100.3cm (FG12-49) to 114.08cm (G16-112). They were statistically significant differences among genotypes when examined over the two seasons (Table 3). Strain FG12-49 was significantly shorter compared the all other genotypes. According to IRRI (2013), plant height can be divided into three categories for lowland rice *viz.* semi-dwarf (<110cm), intermediate (110-130cm) and tall (>130cm). It can be observed that the height of plants recorded in this study ranged from semi-dwarf to intermediate. Plant height varies differentially on the basis of their varietal character, tall plants are not desirable because it is sensitive to lodging and this will ultimately reduce grain yield (Shahidullah et al., 2009). Bhadru et al., (2011) stated that plant height is highly correlated with the level of lodging and ease of harvest so it is one of the important characters in influencing the level of farmer's acceptance of new cultivars. Hence, the semi-dwarf to intermediate plant height of tested lines is likely responsible for the low incidence of lodging experienced during this study which would make them greatly desired by farmers.

Strain FG12-259 produced the highest average of 338 tillers/m^2 which was significantly higher than FG12-49, FG15-01, and G16-108 but similar all other genotypes tested including the check varieties. The check varieties are consider to be low to medium tillering plants thus the newer genotypes fall within the same range of productive tillers. Strain FG12-259 demonstrated the high grain yield production with medium tillering ability, a particularly desirable agronomic trait. Genotypes with significantly higher productive tillers can also provide good option under local conditions as they compensate for poor establishment under flooded conditions.

IRRI (2007) suggest that 300 to 400 panicle/m^2 desired for wet season crop, but populations can be increased under fertile soils and irrigated soils, like Guyana. Wang et al. (2016) indicated that unequal distribution of photo-synthetically active radiation (PAR) is the source of heterogeneity in individual tiller yields, in that the early emerging superior tillers pre-empted the uppermost light source and shade the late emerging tillers under limited light condition, consequently a line/variety can have a large number of tillers but show lower grain yield since late emerging tillers may be unproductive.

Significant variation was observed in grain yield among the tested lines. The highest yielding line was FG12-259 with 7276.6 Kg/ha followed by FG12-49 with 6937.6 Kg/ha, other lines which produced significantly higher yield were GRDB 12 (6661.3kg/ha) and FG14-43 (6623.1kg/ha), however all were statistically similar. Strain G16-112 produced the lowest overall yield (4823.6Kg/ha) in this study (Figure 1). Strains viz. G15-02, G15-11, FG15-01 FG15-02, FG16-02, and FG16-02 showed statistically lower yields, similar to that of G16-112.

Kalyan *et al*. (2017) reported that the number of filled grains per panicle exerted the highest positive direct effect on grain yield followed by 1000 grain weight, number of tillers per plant, number of unproductive tillers per plant, plant height and days to 50% flowering. In addition, Shahriar *et al.* (2014)] in a study on the diversity assessment of yield and yield contributing traits reported high heritability values for 1000 seed weight, number of filled grains per panicle, plant height, unfilled grains per panicle, days to 50% flowering, total tiller per hill and days to maturity. These high heritability values indicated the traits under study in the present trial were perhaps less influenced by environment in their expression, hence these traits can be considered a true representation of the genetic potential of the genotype.

5. CONCLUSION

The yield performance and yield attributing traits of the genotypes assessed varied over the period of evaluation although being tested at the same location, evaluating advanced breeding lines for several years at a target environment is therefore essential in order to isolate genotypes with consistent performance. Breeding line FG12-259 was observed to have performed exceptionally well in the important yield attributing traits and total grain yield (Kg/ha). This promising line (FG12-259) would be of considerable value to breeders engaged in the development of high yielding cultivars, it can therefore be selected for adaptability tests in farmers' fields as it shows promise to proceed in the varietal selection program and become a recommended variety.

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