



## **Performance of F<sub>2</sub> Rice (*Oryza sativa* L.) Segregants Derived from a Cross the BPT-5204 / IR-64Drt1**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author AK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript.*

*Authors DNS and KP managed the analyses of the study. Author AP managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The present investigation was carried out with F<sub>2</sub> plants from a cross between two parents i.e., BPT-5204 and IR-64Drt1. The selection of parents for crosses was made based on genotypes that were tolerant and susceptible to drought condition. BPT-5204 was drought susceptible and IR-64Drt1 was also tolerant to drought. In this experiment adequate amount of variability was detected for grain yield per plant and its components among 324 segregants evaluated under augmented randomized block design II in normal field condition. The analysis of variance for grain yield and its attributing characters among blocks, treatments, entries, checks and checks vs entries revealed presence of significant variation in the segregants studied. However, with respect to checks, non-significant differences were recorded for only L/B ratio. The results indicated that among 324 rice genotypes including checks, only 9 rice genotypes expressed higher yield compared to seven checks varieties under normal field condition. The segregants S-51, S-122, S-135, S-195, S-199, S-210, S-219, S-222, S-251 were top ranking genotypes with respect to all checks.

**Keywords:** Rice; augmented block design II; segregants; variation.

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## 1. INTRODUCTION

Rice (*Oryza sativa* L.) is the most prominent food crop and energy source for about half of the world's population and ranks second in production after wheat [1]. It gives 27 percent of dietary energy and 20 percent of dietary protein in developing countries [2]. Rice is cultivated in at least 114 developing countries and it is the main source of income and employment to more than 100 million households in Asia [3]. It is being cultivated under the diverse environmental condition in the world ranging from irrigated to rainfed and upland to lowland to the deep water system. It is a water-loving crop therefore severely affected by drought stress that reduces yield by 15 – 50% depending on the vigour and period of stress [4,5]. Rice requires more water per unit grain production as comparison to other cereal crops like wheat, maize, sorghum, Pearl millet and finger millet. In view of increasing water scarcity, there is a need to improve alternate systems of rice cultivation that require less water. Drought is considered one of the main abiotic constraints that diminish grain yields of rice in rainfed and poorly irrigated areas. Above 50% of the world's rice is cultivated under rainfed ecology but these non irrigated lands produce only a quarter of total rice output [6]. Water stress has been recognized as one of the chief limitation to rice cultivation in rainfed lowland ecosystems which occupy 28 percent of rice cultivation area in Jharkhand. About 23 million hectares of the rainfed rice area in Asia is expected to be drought-prone and also drought is becoming an increasing problem in traditionally irrigated areas [7]. Overall, 20.7 million ha of rainfed rice area estimated in India, approximately 16.2 million ha lies in eastern India [8] of which 6.3 million ha of upland and 7.3 million ha of lowland area are highly drought-prone [9]. The Indo-Gangetic Plain of the eastern region is one of the major drought-prone rice-producing regions in the world [10]. In this region, damages due to reproductive stage drought constraints are most dangerous for rice-producing states of eastern India viz., Chhattisgarh, Orissa, Jharkhand, Bihar, and eastern Uttar Pradesh. The total losses of rice production in Chhattisgarh, Orissa, and Jharkhand have been described to be as much as 40%, valued at US\$ 650 million in severe drought years [7]. The identification of rice genotypes that could be tolerant to drought stress and produce economic yields is very important in order to improve that increasing food crisis. Although, a fruitful breeding programme will depend on the genetic

diversity of a crop to succeeding the goals of improving the crop and producing high yielding varieties [11]. Therefore, the first step is the characterization of available rice germplasm or genotypes at both morphological and molecular levels as phenotypic and genotypic diversity that is important traits of interest to plant breeders [12]. In-plant breeding programme, the yield is a major goal for Plant breeder hence plant traits that could be selected among  $F_2$  segregants are robust, efficient root systems, well-endowed shoot system, early duration and finally high grain yield. Therefore, keeping the above points in view, the objective of this work is to assess 324  $F_2$  rice segregants for 15 characters and selecting those that have better yield attributes.

## 2. MATERIALS AND METHODS

The present investigation was carried out during Kharif season 2019 at the farm of Birsa Agricultural University, Ranchi, Jharkhand. The experimental site is situated at an altitude of 651m above mean sea level and at 23.4345' N latitude and 85.3214' E longitude. The material under present study was 324  $F_2$  segregants derived from a cross between two parents i.e., BPT-5204 and IR-64Drt1. The selection of parents for crosses was made based on genotypes that were tolerant and susceptible to drought condition. BPT-5204 is drought susceptible and IR-64Drt1 is tolerant to drought. The staggered sowing of the particular parental genotypes was done to achieve synchronization in the flowering for an effective crossing program to generate  $F_1$ . At the time of panicle emergence and flowering stage, the florets of female parents (BPT-5204) were hand emasculated early in the morning, before 7 a.m. and after the pollen was collected from the male parent (IR-64Drt1) and also dusted on to the stigma within 11 am. The seeds set on female plants were harvested, nearby 25-27 days after crossing event. However, The seeds of  $F_2$  segregants were raised in augmented block design-II in nine blocks with seven checks. All the progenies were sown in the raised bed nursery along with their parents and checks. There were seven check varieties also included for comparing viz.,  $F_1$ , IR-64, IR-20, Sahbhagidhan, Vandana, BPT-5204 and IR-64Drt1. Thirty days old seedlings were transplanted to the main field with a spacing of 20 cm between rows and 15 cm between plants to assist tiller angle observations. The recommended agronomic practices and crop protection measures were followed during the crop growth period. The data were recorded on

yield and its attributing components viz. Days to flowering, Number of panicles, Number of total tillers, Plant height (cm), Panicle length (cm), Grain length (mm), Grain width (mm), L/B ratio, Number of primary branches per panicle, Number of secondary branches per panicle, 100 seed weight, Yield per plant (g), Yield per panicle (g), Biomass (g/plant) and Harvest Index %. The means were subjected to analysis on the basis of augmented block design-II (Table 1). The genotypes which showed significant performance for yield and it contributes upon the best checks were selected.

### 3. RESULTS AND DISCUSSION

The analysis of variance for grain yield and its attributing characters among blocks, treatments, checks, entries and checks vs entries stated the presence of significant variation in the segregants of rice. However, with respect to checks non-significant differences were recorded for only L/B ratio while entries, non –significant differences were recorded for panicle length (cm), grain width (mm) and yield per panicle (g) (Table 1).

Earliness is always desirable, as the genotypes that mature early under rainfed would escape from the drought. The examination of data on the days to flowering revealed presence of good variation between the segregants. Maximum number of days were recorded in case of S-8 (129.61), S-45 (124.56), S-77 (123.39), S-27 (121.86), S-31 (121.36), S-110 (121.26), S-40 (120.56), S-44 (118.06), S-50 (119.81), S-59 (119.56), S-78 (118.22), S-73 (117.72), S-58 (115.81), S-65 (115.23) as assessment with check BPT-5204 which flowered very late (113.46 days) while as minimum number of days were taken by S-159 (72.99) with compared to very early flowered check genotype Vandana (78.63 days). It varied from 72.99 to 129.61 (Table 2).

In this study, the early maturing genotypes with high yield were S-51, S-135, S-158, S-199 and S-291 with respect to check IR64 (90.44 days) which produced 20.97 g/plant (Table 2).

There was also significant differences observed for number of total tillers per plant among the rice genotypes. The highest number of total tillers per plant was found in S-2, S-10, S-36, S-51, S-62, S-68, S-75, S-76, S-100, S-106, S-116, S-122, S-136, S-144, S-149, S-169, S-174, S-183, S-

206, S-207, S-210, S-212, S-215, S-222, S-224, S-243, S-258, S-264, S-270, S-275, S-299 with respect to all seven checks (Table 2). It varied from 1.93 to 44.03.

Number of panicles produced by each plant constitutes an important agro-morphological trait for grain yield in rice [13,14]. In present study, significant differences were observed for number of panicles per plant among the rice segregants. The highest number of panicles per plant was found in S-10, S-29, S-36, S-51, S-62, S-68, S-70, S-74, S-76, S-107, S-116, S-122, S-135, S-136, S-144, S-148, S-149, S-152, S-169, S-183, S-206, S-207, S-210, S-212, S-215, S-222, S-224, S-249, S-258, S-264, S-270, S-275, S-299 with respect to all seven checks (Table 2). It varied from 1.64 to 36.38.

It was also reported that the number of tillers per plant contributed maximum direct effect on yield [15]. The number of productive tillers per plant, number of spikelets per panicle, number of grains per panicle and days to maturity had positive direct effect on grain yield per plant [16].

Good amount of variability were present for plant height also. S-5 (91.30 cm) and S-311 (87.35 cm) were tall compared with highest plant height check Shabthagidhan (84.26 cm) while S-6 (52.80 cm), S-12 (55.30 cm), S-14 (52.30 cm), S-25 (35.80 cm), S-27 (52.05 cm), S-31 (48.80 cm), S-32 (55.30 cm), S-37(49.54 cm), S-38 (51.79 cm), S-39 (47.04 cm), S-40 (39.54 cm), S-44 (54.54 cm), S-45 (50.54 cm), S-49 (46.54 cm), S-50 (51.54 cm), S-54 (40.87 cm), S-56 (55.54 cm), S-57 (49.54 cm), S-58 (49.54 cm), S-59 (52.79), S-74 (55.27 cm), S-75 (53.94 cm), S-76 (52.94 cm), S-77 (34.27 cm), S-78 (50.94 cm), S-81 (50.44 cm), S-85 (55.61), S-94 (55.94 cm), S-99 (48.19m), S-110 (52.99 cm), S-114 (54.49 cm), S-118 (54.49 cm), S-120 (51.49 cm), S-121 (55.49 cm), S-130 (51.49 cm), S-134 (46.74 cm), S-146 (55.38 cm), S-150 (49.88 cm), S-159 (49.71 cm), S-175 (53.88 cm), S-179 (52.88 cm), S-185 (44.63 cm), S-200 (45.13 cm), S-202 (53.13), S-204 (52.13 cm), S-213 (S-213 cm), S-214 (52.63 cm), S-218 (52.94 cm), S-220 (53.94 cm), S-225 (52.69 cm), S-227 (52.94 cm), S-229 (50.94 cm), S-231 (55.44 cm), S-247 (53.44 cm), S-250 (54.94 cm), S-254 (53.27 cm), S-256 (43.61 cm), S-257 (37.94 cm), S-259 (51.94 cm), S-262 (53.44 cm), S-263 (54.94 cm), S-264 (52.94 cm), S-267 (50.27 cm), S-268 (53.44 cm), S-272 (53.94 cm), S-273 (54.94 cm), S-285 (54.27 cm), S-300 (49.35 cm), S-313 (55.35 cm), S-314 (53.85 cm) and S-319

**Table 1. Augmented design-II Analysis of variance for yield and its attributing characters**

SOV	D.F	Mean squares														
		Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches Per Panicle	Secondary branches Per Panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain Weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
Blocks	8	63.255**	152.521**	103.501**	634.412**	89.571**	5.096**	187.874**	0.149**	0.007	0.117**	0.109**	1240.735**	0.047**	0.662	206.834**
Treat	330	75.101**	34.682**	28.131**	101.360**	498.666**	1.810**	31.740**	0.317**	0.031	0.002	0.134**	250.812**	0.019**	0.436	50.946**
Entries	323	49.476**	32.912**	26.640**	75.962**	4.497	1.835**	34.313**	0.175**	0.024	0.004**	0.078**	230.581**	0.017**	0.180	38.584**
Check	6	1060.212**	256.774**	186.595**	902.870**	902.870**	2.326*	38.976*	5.876**	0.441**	0.002	2.063**	1445.654**	0.130**	6.803**	365.270**
Check x entries	1	2441.395**	-726.119	-441.040	3495.787	157690.12	-9.364	-842.668	12.818**	0.107*	-0.787	6.930**	-383.451	0.093*	44.863**	2158.020**
Error	48	17.661	15.192	14.748	26.939	2.634	0.958	16.108	0.021	0.022	0.002	0.007	83.298	0.005	0.390	20.510

\*Significant at 5% level, \*\*Significant at 1% level, DF- Degree of freedom, SOV- Source of variation

**Table 2. Adjusted mean of 324 genotypes including checks using augmented design**

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-1	101.11	12.03	9.63	60.80	25.30	8.62	20.53	7.36	2.56	3.11	1.70	13.67	0.19	-0.20	3.99
S-2	101.61	24.03	18.63	55.80	25.30	10.12	34.53	7.46	2.66	3.11	1.69	33.66	0.09	-0.31	4.90
S-3	94.61	15.53	12.88	65.80	25.80	9.37	26.78	7.53	2.71	3.11	2.31	20.87	0.32	0.08	7.86
S-4	98.61	17.53	17.13	59.30	23.80	12.12	35.03	7.66	2.56	3.12	1.57	33.04	0.15	-0.21	6.24
S-5	90.36	11.53	11.38	91.30	28.30	10.12	29.53	7.68	2.38	3.11	1.98	103.31	0.13	1.32	14.12
S-6	100.11	10.03	9.13	52.80	21.30	9.12	39.53	7.56	2.76	3.11	2.51	12.01	0.29	-0.14	4.39
S-7	94.61	13.53	13.13	74.80	25.80	9.12	29.53	8.16	2.66	3.10	1.84	76.69	0.14	0.47	9.19
S-8	129.61	19.20	12.79	57.30	21.96	9.45	37.19	8.36	2.59	3.10	2.10	32.01	0.11	-0.17	5.25
S-9	102.61	13.03	10.63	56.80	22.80	10.12	47.53	8.26	2.86	3.10	2.49	66.59	0.09	0.25	7.46
S-10	93.61	26.87	20.13	64.63	23.63	8.78	34.78	8.03	2.89	3.11	1.84	23.19	0.21	-0.14	8.51
S-11	97.61	19.03	15.13	56.80	22.80	10.62	41.03	8.41	2.51	3.10	2.00	19.83	0.28	-0.16	6.50
S-12	99.11	14.03	12.63	55.30	21.80	12.62	27.03	8.46	2.66	3.11	2.33	27.28	0.16	-0.13	7.92
S-13	99.95	17.53	13.46	61.96	22.96	8.78	32.86	7.69	2.83	3.11	1.86	21.88	0.21	-0.18	5.75
S-14	99.11	9.53	8.13	52.30	21.30	10.12	20.53	8.86	2.96	3.12	2.29	38.00	0.16	0.50	7.60
S-15	101.61	10.53	9.79	57.96	21.96	9.12	29.19	8.83	2.79	3.14	1.61	33.50	0.06	-0.19	5.19

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-16	94.61	18.53	17.13	68.80	24.30	12.12	27.03	8.96	3.06	3.15	1.84	23.88	0.51	0.22	11.72
S-17	100.61	14.03	12.63	58.30	24.30	9.62	39.03	8.91	2.66	3.15	1.54	14.59	0.23	-0.25	4.63
S-18	94.61	15.53	14.63	57.80	23.80	8.62	27.53	8.66	2.56	3.15	1.99	49.43	0.15	-0.03	9.47
S-19	98.61	16.53	15.88	61.30	22.80	8.87	29.53	8.11	2.73	3.15	2.32	26.02	0.35	-0.01	9.19
S-20	95.61	18.53	16.63	71.80	25.30	9.12	22.53	7.98	2.53	3.16	1.96	19.00	0.36	0.09	7.50
S-21	91.36	14.28	12.88	71.30	25.55	10.12	33.78	7.38	2.66	3.16	2.14	32.89	0.27	0.34	10.03
S-22	98.61	18.53	16.63	58.30	22.80	10.62	32.03	7.56	2.86	3.16	2.46	23.33	0.29	-0.17	6.69
S-23	97.11	17.78	15.63	64.55	24.55	8.37	20.28	7.66	2.71	3.17	2.47	35.13	0.22	-0.02	8.53
S-24	94.28	21.20	18.13	66.63	25.96	11.78	42.19	8.39	2.39	3.19	1.73	21.55	0.32	-0.14	7.48
S-25	105.11	8.03	6.13	35.80	16.80	13.12	34.53	8.26	2.66	3.19	2.54	52.98	0.03	-0.09	3.46
S-26	99.11	14.03	12.63	57.30	24.30	10.12	28.03	7.56	2.66	3.19	2.32	37.27	0.15	-0.04	7.38
S-27	121.86	19.78	17.38	52.05	22.55	9.62	30.53	7.61	2.58	3.19	1.98	25.21	0.19	-0.24	5.84
S-28	98.11	14.03	11.63	63.80	22.30	13.12	50.53	7.91	2.76	3.19	1.53	29.89	0.14	-0.09	5.55
S-29	95.61	22.03	19.63	77.80	24.30	9.12	26.53	7.96	2.86	3.19	2.28	48.69	0.17	-0.07	9.37
S-30	96.86	18.53	16.88	60.55	22.80	7.87	18.78	8.03	2.88	3.20	2.07	17.39	0.29	-0.22	6.08
S-31	121.36	11.53	9.38	48.80	20.80	8.37	24.53	8.21	2.96	3.20	2.30	34.85	0.08	-0.12	4.45
S-32	98.61	9.53	8.63	55.30	22.30	9.12	24.53	8.51	2.63	3.21	2.04	35.24	0.08	-0.08	4.44
S-33	98.28	16.53	14.79	72.96	24.30	8.45	26.19	8.83	2.66	3.23	2.04	23.96	0.59	0.49	13.62
S-34	96.61	17.53	16.79	74.63	25.30	10.12	31.86	8.43	2.73	3.22	2.31	41.83	0.24	0.15	11.66
S-35	101.61	15.53	13.63	62.30	23.30	11.62	36.53	8.36	2.86	3.22	2.14	20.27	0.27	-0.12	5.98
S-36	94.11	32.03	27.13	76.30	25.30	8.62	22.53	8.56	2.36	3.22	2.52	47.24	0.29	-0.03	13.10
S-37	95.90	12.02	10.72	49.54	15.54	9.40	23.79	8.45	2.36	3.20	2.37	25.81	0.15	0.52	4.83
S-38	96.81	17.69	15.64	51.79	14.04	9.57	31.04	8.17	2.49	3.20	1.99	26.20	0.15	0.39	5.34
S-39	98.81	10.44	9.39	47.04	12.29	8.82	25.29	7.97	2.57	3.21	2.07	27.18	0.13	0.50	5.08
S-40	120.56	19.19	17.89	39.54	11.54	12.57	35.79	7.27	2.69	3.19	2.44	27.68	0.11	0.29	4.35
S-41	95.06	12.19	8.39	58.54	15.04	9.07	26.79	7.47	2.79	3.20	2.40	31.92	0.16	1.01	6.24
S-42	99.06	20.69	18.89	63.04	13.54	8.07	23.79	8.82	2.54	3.20	2.50	63.92	0.22	0.99	17.83
S-43	93.56	18.69	16.39	59.54	15.04	8.57	28.79	8.77	2.59	3.19	2.30	36.25	0.07	0.32	4.43
S-44	118.06	13.19	11.89	54.54	14.29	10.07	35.54	7.44	2.62	3.17	2.44	16.72	0.32	0.53	5.29
S-45	124.56	15.02	13.05	50.54	14.20	11.07	37.12	7.75	2.63	3.18	1.75	39.59	0.02	0.29	3.21
S-46	97.81	10.94	10.39	56.04	15.04	11.32	36.29	7.24	2.37	3.19	1.74	17.40	0.22	0.48	4.33
S-47	99.56	9.69	7.89	71.04	14.54	10.07	25.79	7.92	2.89	3.19	2.05	13.11	0.41	1.12	7.34
S-48	92.06	16.44	15.14	72.54	18.54	12.07	37.79	8.27	2.72	3.16	2.43	23.25	0.51	1.22	16.32
S-49	97.56	10.19	7.39	46.54	12.54	11.57	33.79	7.52	2.59	3.15	2.43	22.76	0.10	0.55	2.98

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-50	119.81	19.94	18.14	51.54	15.79	9.32	27.04	7.67	2.44	3.16	2.06	43.25	0.12	0.45	7.32
S-51	88.90	24.36	22.72	73.54	19.20	12.74	37.12	7.95	2.56	3.16	1.82	55.57	0.46	1.30	27.04
S-52	100.56	6.36	5.05	62.87	16.20	11.07	30.79	8.32	2.49	3.15	2.47	13.54	0.47	1.21	5.06
S-53	92.31	17.19	15.89	65.29	17.54	10.32	32.54	8.69	2.57	3.17	1.96	32.31	0.27	0.71	10.54
S-54	101.56	12.36	10.39	40.87	10.20	12.07	31.45	7.38	2.66	3.17	2.48	27.77	0.07	0.29	2.75
S-55	104.06	12.19	9.64	59.54	16.54	12.07	41.79	8.17	2.54	3.17	2.14	36.75	0.08	0.60	5.00
S-56	97.06	13.19	12.39	55.54	13.54	10.07	30.79	8.42	2.29	3.17	2.50	24.98	0.25	0.66	6.44
S-57	103.90	6.36	6.05	49.54	15.20	11.07	31.45	8.35	2.46	3.17	1.99	12.50	0.13	0.49	2.18
S-58	115.81	14.69	12.64	49.54	12.79	11.57	36.29	7.84	2.57	3.14	1.96	46.63	0.05	0.45	5.12
S-59	119.56	15.44	14.14	52.79	13.79	11.57	34.29	7.94	2.52	3.15	2.11	38.47	0.10	0.46	6.48
S-60	95.56	14.69	14.39	61.54	17.04	11.57	44.79	8.52	2.39	3.16	1.75	22.30	0.19	0.41	5.33
S-61	93.06	17.69	16.89	65.54	16.04	10.07	23.29	8.47	2.34	3.16	2.21	35.52	0.19	0.58	8.29
S-62	92.56	26.69	25.39	60.87	14.87	10.74	30.45	8.48	2.79	3.15	1.71	31.65	0.36	0.47	11.01
S-63	91.56	22.02	19.39	62.54	17.20	11.40	29.12	8.72	2.89	3.15	1.83	20.85	0.39	0.41	7.15
S-64	93.81	12.19	11.39	58.04	15.54	12.07	33.54	8.64	2.57	3.16	2.17	37.02	0.10	0.57	5.97
S-65	115.23	19.02	17.05	57.54	15.54	10.32	34.04	8.45	2.53	3.16	2.18	35.92	0.15	0.48	6.91
S-66	97.56	10.36	9.72	63.20	16.20	11.07	30.45	7.82	2.49	3.15	1.80	19.19	0.35	0.88	7.54
S-67	95.56	17.19	16.89	60.04	16.54	12.57	35.79	8.27	2.39	3.15	1.93	50.71	0.23	0.96	15.46
S-68	93.06	30.69	28.89	64.04	18.04	10.57	21.79	8.57	2.59	3.15	1.67	48.00	0.52	0.87	22.98
S-69	93.90	11.02	10.39	67.87	18.20	8.74	23.12	8.78	2.73	3.15	1.84	20.63	0.39	0.93	9.04
S-70	92.56	22.69	21.39	69.04	18.54	8.57	24.79	7.92	2.69	3.15	2.10	45.07	0.46	1.12	22.51
S-71	93.56	16.19	15.89	60.04	14.04	11.57	31.29	8.42	2.94	3.15	1.63	37.47	0.30	0.89	12.66
S-72	101.56	14.36	12.72	63.87	17.20	10.74	23.12	8.45	2.83	3.15	1.85	40.87	0.09	0.70	6.15
S-73	117.72	22.32	19.19	48.61	15.27	7.65	28.57	8.11	2.56	3.17	2.14	37.49	0.16	0.05	3.24
S-74	95.05	21.65	19.85	55.27	15.61	12.65	41.74	7.31	2.53	3.16	1.89	29.51	0.32	0.19	6.79
S-75	94.72	23.32	19.52	53.94	13.94	11.15	41.24	8.60	2.60	3.17	1.99	19.66	0.20	-0.10	0.67
S-76	99.72	30.82	27.02	52.94	10.94	12.15	32.74	8.00	2.80	3.16	1.97	35.07	0.19	-0.07	3.75
S-77	123.39	11.65	8.85	34.27	7.94	10.99	36.57	8.25	2.55	3.18	1.74	26.73	0.03	-0.13	-3.18
S-78	118.22	13.82	12.52	50.94	12.94	11.15	36.99	7.80	2.67	3.17	1.91	29.29	0.10	-0.04	-0.27
S-79	95.05	12.65	10.85	62.61	14.61	11.99	42.24	7.41	2.56	3.18	2.05	24.70	0.11	0.05	-0.62
S-80	98.22	18.82	16.02	66.94	13.44	9.65	41.74	7.92	2.67	3.17	1.82	22.83	0.20	0.03	1.90
S-81	96.72	17.82	16.02	50.44	12.44	9.65	21.24	8.32	2.37	3.17	1.79	20.59	0.10	-0.16	-1.11
S-82	98.05	13.32	12.19	61.61	14.27	10.32	24.24	8.41	2.32	3.15	1.74	27.45	0.22	0.35	3.70
S-83	96.05	22.32	18.52	58.27	15.61	11.32	33.91	7.78	2.63	3.16	2.06	30.19	0.19	0.05	3.17

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-84	99.22	18.32	15.52	57.44	12.69	9.90	24.99	8.20	2.85	3.17	1.78	22.93	0.12	-0.12	-0.68
S-85	97.72	17.65	15.19	55.61	12.27	10.65	35.57	8.61	2.63	3.17	2.37	22.40	0.19	0.05	1.63
S-86	94.47	14.57	12.52	59.19	14.44	7.90	20.49	7.80	2.92	3.16	1.69	26.90	0.28	0.60	6.01
S-87	91.72	21.32	17.27	64.69	13.94	10.40	30.24	8.37	2.75	3.16	2.03	27.43	0.22	0.07	3.66
S-88	94.22	9.82	9.02	53.94	12.44	10.65	33.24	8.20	2.50	3.16	1.93	25.05	0.16	0.34	0.74
S-89	93.97	14.82	12.02	58.19	12.94	13.15	25.74	7.82	2.47	3.15	1.62	25.33	0.21	0.31	2.66
S-90	100.47	18.82	16.52	53.69	10.19	10.15	30.99	8.37	2.57	3.15	2.16	29.25	0.21	0.15	4.12
S-91	118.22	14.07	12.77	62.69	13.19	10.15	29.99	7.42	2.72	3.18	1.90	19.18	0.19	0.06	1.42
S-92	94.97	17.57	15.02	67.19	15.19	8.15	23.49	7.82	2.42	3.19	2.11	21.57	0.23	0.12	2.34
S-93	101.72	19.82	17.02	56.94	14.44	8.65	33.24	8.05	2.65	3.19	1.79	25.32	0.22	0.12	3.11
S-94	98.22	17.82	15.52	55.94	13.44	8.15	18.74	8.05	2.80	3.18	1.82	22.41	0.23	0.10	2.51
S-95	95.05	15.99	14.19	58.61	13.61	10.32	36.24	8.41	2.93	3.20	1.96	23.38	0.23	0.19	3.17
S-96	91.22	11.07	10.27	67.44	14.44	11.15	36.49	8.57	2.60	3.19	2.29	25.12	0.28	0.73	5.70
S-97	93.22	15.32	13.52	67.94	15.44	10.65	22.74	7.60	2.60	3.20	2.28	18.88	0.23	0.14	2.36
S-98	92.72	18.82	16.77	65.94	14.44	9.40	21.49	8.17	2.67	3.19	2.03	19.05	0.19	-0.04	0.73
S-99	101.22	12.82	11.27	48.19	9.94	9.40	21.49	8.32	2.37	3.20	1.81	21.17	0.14	0.04	-0.20
S-100	99.47	23.32	21.27	56.19	13.19	10.90	31.49	8.50	2.70	3.18	2.01	37.10	0.12	-0.08	1.48
S-101	102.22	16.82	12.02	58.94	11.94	8.65	32.24	7.90	2.60	3.18	2.48	16.25	0.14	-0.06	-1.36
S-102	100.72	14.65	13.52	62.27	14.61	10.99	28.57	8.42	2.52	3.20	1.79	41.39	0.23	0.60	7.65
S-103	96.47	13.32	11.02	63.44	14.44	13.15	40.24	8.32	2.37	3.19	1.94	36.84	0.22	0.68	6.29
S-104	94.22	17.32	16.27	71.69	15.19	9.90	28.49	7.90	2.55	3.17	1.89	35.55	0.39	0.80	12.82
S-105	92.39	17.65	13.85	72.61	17.27	8.99	28.24	8.28	2.70	3.17	2.36	35.18	0.18	0.27	3.62
S-106	92.72	22.99	19.19	63.61	12.94	9.99	24.91	8.61	2.36	3.18	1.79	40.70	0.12	-0.03	1.69
S-107	93.72	22.32	20.19	66.94	15.61	8.99	22.24	8.28	2.80	3.16	1.78	45.71	0.18	0.16	5.48
S-108	91.22	18.82	16.02	55.94	12.94	10.15	22.74	8.40	2.90	3.18	2.24	41.06	0.19	0.29	6.03
S-109	96.76	8.75	7.89	62.99	15.49	11.04	41.78	8.39	2.69	3.08	2.34	69.34	0.20	1.44	11.43
S-110	121.26	16.58	15.22	52.99	13.32	10.38	26.11	8.59	2.76	3.08	1.94	43.16	0.22	1.03	10.58
S-111	94.51	11.25	10.89	69.99	18.24	10.04	29.78	8.54	2.56	3.09	1.99	41.77	0.54	2.72	23.95
S-112	96.92	9.58	9.89	68.32	18.65	8.04	18.78	7.79	2.46	3.10	1.97	26.91	0.48	1.63	15.73
S-113	95.76	16.75	16.39	62.49	16.74	11.29	26.03	8.46	2.61	3.11	2.04	30.70	0.24	0.82	8.36
S-114	96.76	6.25	6.39	54.49	12.99	12.04	41.78	8.69	2.69	3.11	2.22	21.22	0.45	1.72	11.47
S-115	100.76	14.25	12.39	57.99	14.49	9.04	20.28	7.59	2.59	3.12	2.50	21.64	0.21	0.72	6.34
S-116	96.26	23.75	23.14	63.99	14.99	11.29	37.28	7.86	2.44	3.13	2.18	46.95	0.39	1.12	21.51
S-117	95.51	8.75	8.89	61.24	17.74	10.54	31.03	7.94	2.96	3.14	2.24	25.49	0.30	1.14	10.24

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-118	103.26	4.75	4.39	54.49	12.49	13.04	27.78	8.19	2.84	3.16	1.34	8.50	0.27	0.89	4.25
S-119	89.51	8.75	8.64	68.24	17.49	7.79	19.03	8.09	2.59	3.16	1.88	37.02	0.15	0.81	6.65
S-120	105.76	17.75	18.39	51.49	12.99	9.04	22.28	7.39	2.44	3.16	2.01	42.93	0.16	0.67	7.65
S-121	97.26	3.25	1.89	55.49	12.99	11.04	33.28	8.19	2.54	3.17	1.59	22.61	0.18	1.97	5.54
S-122	93.26	25.25	25.89	69.99	18.99	11.54	29.28	8.39	2.69	3.16	2.12	71.26	0.39	1.41	28.88
S-123	93.26	15.25	14.39	71.99	17.99	11.54	28.28	8.29	2.64	3.16	2.08	58.16	0.36	1.70	22.43
S-124	121.76	15.75	13.89	47.49	10.99	9.04	28.28	8.39	2.64	3.15	1.76	39.52	0.20	0.85	9.13
S-125	97.26	11.25	11.39	62.49	16.49	9.79	26.28	8.34	2.81	3.16	2.01	38.75	0.28	1.18	12.81
S-126	104.26	12.75	10.89	56.24	13.74	9.54	28.53	8.49	2.56	3.17	2.04	41.11	0.14	0.79	6.84
S-127	92.76	12.50	14.39	65.99	16.74	10.54	22.03	7.89	2.29	3.17	1.80	49.24	0.27	1.27	15.61
S-128	103.01	12.00	10.14	62.74	14.99	9.79	30.53	8.16	2.76	3.17	2.24	45.71	0.24	1.35	12.00
S-129	94.26	10.75	11.39	59.49	14.74	9.54	32.28	7.21	2.56	3.18	1.88	10.71	0.57	0.87	8.78
S-130	105.51	13.75	13.64	51.49	13.99	11.79	30.28	7.34	2.81	3.19	1.53	20.53	0.62	1.40	16.31
S-131	122.26	13.92	11.89	56.99	13.32	9.04	25.11	7.59	2.52	3.20	2.21	23.25	0.20	0.72	6.19
S-132	96.26	11.75	10.89	57.99	14.49	10.54	36.78	7.49	2.59	3.19	2.22	25.17	0.20	0.74	7.22
S-133	96.26	14.25	13.39	55.99	14.99	8.54	23.28	8.19	2.69	3.20	2.42	36.23	0.36	1.28	14.77
S-134	125.51	12.75	11.89	46.74	12.49	8.79	25.28	8.46	2.61	3.19	2.16	39.08	0.14	0.72	6.24
S-135	90.26	22.75	23.39	59.49	17.49	9.54	29.28	7.49	2.59	3.18	1.74	74.26	0.43	1.66	33.09
S-136	97.26	24.25	22.39	64.99	13.49	11.54	34.28	7.99	2.54	3.19	1.59	42.63	0.27	0.90	11.80
S-137	92.51	11.75	12.14	74.74	18.24	9.54	27.03	8.21	2.71	3.19	1.68	57.31	0.16	0.95	9.33
S-138	95.26	6.25	6.64	70.49	15.99	9.54	27.53	8.64	2.41	3.20	2.09	54.86	0.15	1.26	8.64
S-139	101.01	10.75	9.89	63.49	17.24	10.54	31.03	7.84	2.61	3.17	2.26	45.75	0.13	0.83	6.64
S-140	93.26	18.92	18.22	64.99	15.65	8.38	19.78	8.05	2.46	3.18	1.74	67.81	0.21	0.94	13.30
S-141	95.26	16.25	15.89	59.99	15.99	9.04	21.28	8.79	2.79	3.17	2.09	15.98	0.35	1.18	9.00
S-142	97.51	14.75	14.39	59.99	15.74	11.79	39.78	8.26	2.81	3.16	2.07	26.42	0.25	0.79	8.47
S-143	102.26	19.75	17.39	56.49	14.99	10.04	32.78	8.29	2.59	3.16	1.64	23.08	0.16	0.56	5.42
S-144	95.26	25.25	22.89	60.99	16.99	10.04	26.78	8.39	2.69	3.18	2.22	64.87	0.20	0.86	13.66
S-145	96.99	16.92	13.86	58.38	15.88	8.69	22.75	8.39	2.48	3.27	2.49	59.22	0.06	-0.25	4.58
S-146	100.49	16.92	14.36	55.38	17.38	8.69	23.25	8.49	2.23	3.27	2.24	30.55	0.13	-0.22	5.05
S-147	89.99	13.42	12.86	70.38	18.13	11.19	22.25	7.77	2.48	3.26	2.10	46.36	0.24	0.23	10.44
S-148	91.24	21.42	20.36	63.88	17.88	10.44	29.00	8.02	2.56	3.26	2.00	71.83	0.29	0.55	22.11
S-149	94.66	27.92	26.36	62.88	18.38	8.69	21.75	8.13	2.57	3.25	1.69	56.49	0.25	0.02	14.91
S-150	114.49	20.92	16.86	49.88	14.38	9.19	23.75	7.69	2.58	3.26	1.82	68.19	0.11	-0.04	8.38
S-151	98.99	19.42	15.86	59.88	15.88	10.69	30.25	8.26	2.47	3.25	2.03	31.97	0.20	-0.07	7.30



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S-152	96.66	21.42	19.86	67.38	18.38	10.85	29.92	8.43	2.77	3.24	2.34	37.48	0.28	0.04	11.59
S-153	90.49	16.42	15.86	69.38	18.88	9.69	28.25	7.74	2.63	3.17	2.43	43.21	0.38	0.57	17.31
S-154	94.66	12.08	11.53	58.38	17.38	10.19	29.25	8.13	2.50	3.18	2.43	29.77	0.22	0.08	8.54
S-155	91.33	15.08	12.53	71.05	18.38	10.19	31.92	7.93	2.37	3.18	2.27	41.69	0.23	0.42	11.04
S-156	92.49	14.92	14.36	55.88	12.38	10.19	27.25	7.09	2.58	3.16	1.69	45.34	0.29	0.52	14.00
S-157	91.33	14.75	11.86	64.71	15.71	10.19	27.92	7.26	2.50	3.17	2.17	41.22	0.18	0.18	8.46
S-158	88.99	16.92	15.86	63.88	17.88	8.69	24.75	7.39	2.78	3.18	2.18	49.85	0.44	0.95	22.77
S-159	72.99	13.08	10.53	49.71	14.38	11.52	24.92	8.16	2.57	3.16	1.82	27.88	0.14	-0.10	5.15
S-160	90.99	9.42	8.36	58.38	15.38	10.19	27.25	8.29	2.33	3.16	1.52	20.73	0.49	0.85	10.79
S-161	88.49	21.92	19.36	68.38	18.88	10.69	29.25	8.59	2.63	3.15	1.97	48.11	0.36	0.44	18.51
S-162	92.49	16.92	16.36	70.88	17.88	10.19	27.25	8.44	2.73	3.14	2.29	51.58	0.36	0.73	21.39
S-163	91.33	19.42	16.86	63.38	16.05	10.52	28.58	8.16	2.83	3.14	1.70	47.16	0.23	0.18	13.16
S-164	96.99	8.92	7.36	60.38	15.38	10.69	29.25	7.94	2.88	3.16	1.54	13.69	0.29	0.47	5.26
S-165	93.49	17.42	16.86	62.88	18.38	13.19	28.25	7.79	2.63	3.16	2.21	34.73	0.52	0.71	19.83
S-166	92.49	14.42	13.86	68.38	17.88	10.69	29.75	8.04	2.53	3.17	2.29	57.39	0.21	0.45	13.46
S-167	100.99	18.67	15.61	58.63	15.38	11.69	29.75	8.12	2.63	3.17	1.94	52.62	0.10	-0.18	6.20
S-168	96.99	14.75	12.53	58.71	14.38	12.19	35.58	8.56	2.47	3.17	1.87	35.37	0.11	-0.18	4.94
S-169	95.66	24.92	21.36	57.38	13.38	12.69	36.75	7.63	2.37	3.17	2.32	18.28	0.40	0.02	8.00
S-170	100.24	11.42	9.86	62.88	16.63	9.19	24.75	7.67	2.58	3.15	1.74	42.22	0.17	0.25	8.23
S-171	90.99	17.92	17.36	67.38	16.38	8.69	21.75	8.19	2.48	3.16	2.25	46.75	0.29	0.33	14.53
S-172	94.24	18.92	15.86	52.38	15.88	10.19	34.50	8.02	2.66	3.16	2.04	22.18	0.56	0.44	13.20
S-173	92.49	8.67	7.61	64.13	15.88	9.94	24.00	7.34	2.51	3.14	1.88	20.88	0.26	0.26	6.89
S-174	96.49	27.92	14.86	57.38	16.38	8.94	28.00	7.64	2.76	3.15	2.23	17.18	0.41	0.00	7.54
S-175	93.99	9.92	7.86	53.88	17.38	9.19	25.25	8.39	2.78	3.13	2.51	21.20	0.41	0.68	9.03
S-176	100.99	14.42	11.86	56.88	17.38	10.19	24.75	8.44	2.43	3.13	2.23	25.93	0.31	0.23	8.93
S-177	92.33	10.75	9.20	65.38	16.63	11.52	31.25	8.03	2.57	3.10	1.67	25.79	0.17	-0.01	5.46
S-178	100.33	16.75	13.86	57.71	13.88	11.52	31.25	7.26	2.53	3.11	2.36	31.41	0.21	0.00	7.65
S-179	99.49	14.17	12.61	52.88	14.38	12.44	30.50	7.54	2.63	3.12	2.30	30.42	0.16	-0.12	5.88
S-180	99.99	12.42	10.86	62.88	13.88	12.69	34.75	7.86	2.27	3.13	2.41	36.38	0.49	1.32	18.57
S-181	104.47	10.62	8.47	50.88	14.63	10.21	25.42	7.14	2.54	3.17	1.86	28.15	0.09	0.23	0.79
S-182	99.22	4.87	2.72	53.13	14.13	12.46	27.67	7.42	2.71	3.18	1.91	6.54	0.31	0.77	0.64
S-183	103.22	24.37	22.22	53.13	16.13	11.96	42.17	8.32	2.39	3.18	2.41	60.38	0.15	0.33	8.66
S-184	92.55	8.53	6.55	54.96	13.30	10.63	30.00	8.38	2.41	3.19	1.68	15.11	0.18	0.32	1.37
S-185	104.72	8.37	8.72	44.63	15.63	11.96	21.67	8.62	2.44	3.16	1.50	12.61	0.28	0.37	3.40

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-186	104.22	16.37	13.72	65.63	16.63	11.96	31.17	7.62	2.64	3.15	1.86	26.04	0.19	0.28	2.38
S-187	92.72	17.87	17.22	66.13	17.63	8.46	22.67	8.12	2.84	3.14	2.11	25.18	0.52	0.61	11.31
S-188	97.22	9.87	8.72	58.63	14.63	10.46	31.67	8.22	2.44	3.15	2.31	24.75	0.13	0.29	1.61
S-189	95.72	10.87	10.22	64.63	16.63	8.46	23.67	7.72	2.54	3.15	2.16	16.38	0.37	0.59	4.45
S-190	94.72	12.87	12.72	63.63	17.63	10.46	33.67	7.82	2.59	3.15	2.46	37.36	0.20	0.55	6.46
S-191	99.22	11.87	10.55	68.63	17.96	10.29	29.67	8.72	2.31	3.16	1.65	30.89	0.23	0.62	6.02
S-192	98.55	9.87	8.22	63.63	15.96	10.63	32.00	8.48	2.51	3.15	1.97	19.17	0.10	0.16	-0.08
S-193	92.22	10.87	9.72	70.63	18.63	8.96	29.67	8.62	2.59	3.14	1.81	38.44	0.52	1.96	20.99
S-194	90.72	8.87	7.72	63.63	17.63	11.46	32.00	8.32	2.49	3.14	1.66	26.99	0.41	1.37	11.14
S-195	90.72	19.87	17.22	70.13	18.63	11.46	29.67	8.27	2.54	3.13	1.96	54.14	0.45	1.50	25.81
S-196	98.22	7.37	5.22	57.13	19.63	8.96	32.00	7.87	2.74	3.14	1.40	19.80	0.28	0.93	4.46
S-197	97.72	13.37	10.22	60.13	15.13	11.46	29.67	8.02	2.44	3.15	2.27	20.22	0.15	0.21	1.25
S-198	93.72	14.87	14.72	68.63	20.13	11.46	32.00	8.42	2.54	3.15	1.85	41.78	0.42	1.11	17.81
S-199	80.89	14.20	13.55	74.96	19.96	12.29	34.67	8.58	2.47	3.14	1.72	57.49	0.58	2.33	36.37
S-200	106.72	10.87	10.22	45.13	13.63	10.46	32.17	8.22	2.64	3.15	1.55	31.35	0.11	0.26	1.82
S-201	105.22	11.87	10.22	61.13	17.63	10.46	30.17	7.32	2.74	3.16	2.26	42.94	0.25	0.96	10.66
S-202	105.22	19.37	16.22	53.13	14.13	7.46	20.67	7.17	2.54	3.15	1.63	38.80	0.13	0.23	4.09
S-203	100.22	14.20	11.89	61.30	17.63	11.63	32.00	7.48	2.47	3.15	1.84	33.69	0.20	0.49	6.16
S-204	103.22	9.87	9.22	52.13	16.63	9.46	31.67	7.82	2.49	3.15	2.33	44.84	0.24	1.13	10.60
S-205	101.72	10.87	9.72	75.63	20.63	8.46	26.67	7.82	2.24	3.15	2.16	24.49	0.45	1.00	10.44
S-206	92.22	33.53	29.55	70.96	17.96	11.63	34.00	8.52	2.74	3.14	1.77	49.56	0.33	0.53	16.93
S-207	95.72	25.87	21.72	63.63	17.63	12.96	37.67	7.72	2.89	3.15	2.31	28.49	0.23	0.19	5.11
S-208	99.22	21.53	17.89	63.30	17.63	11.96	32.33	7.82	2.61	3.15	2.13	50.10	0.12	0.27	5.18
S-209	96.72	9.37	6.72	67.13	18.13	12.46	35.67	8.02	2.44	3.15	1.71	22.70	0.24	0.76	3.90
S-210	97.22	25.87	25.22	71.63	20.13	10.96	35.17	8.12	2.34	3.15	1.48	69.03	0.48	1.31	34.61
S-211	97.22	11.37	8.22	59.63	17.63	9.96	23.67	8.22	2.59	3.15	2.46	25.30	0.11	0.26	1.06
S-212	97.72	27.37	24.72	66.63	17.13	12.46	35.17	8.22	2.84	3.16	2.52	48.00	0.23	0.38	10.98
S-213	102.89	7.53	3.89	48.96	15.63	12.29	36.00	8.25	2.64	3.18	2.40	15.99	0.24	1.73	7.02
S-214	101.22	9.53	7.22	52.63	16.30	11.96	35.67	7.32	2.41	3.19	2.14	12.70	0.45	0.54	2.95
S-215	92.72	26.87	22.72	71.63	18.63	8.46	22.17	8.62	2.64	3.20	2.15	64.53	0.33	0.89	21.61
S-216	93.22	12.87	12.55	81.96	19.96	11.63	34.33	7.35	2.81	3.21	1.59	63.89	0.23	1.68	23.08
S-217	97.33	19.03	15.88	57.94	16.44	10.04	34.20	8.17	2.36	3.24	2.08	29.85	0.37	1.10	12.01
S-218	102.83	14.03	9.38	52.94	17.94	12.54	36.70	8.22	2.46	3.24	1.98	31.86	0.21	1.09	8.39
S-219	95.33	20.87	19.71	71.61	20.61	11.71	36.20	7.72	2.56	3.24	2.06	68.77	0.59	2.38	36.60

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-220	106.33	16.03	12.38	53.94	14.94	8.54	27.70	7.42	2.61	3.24	1.68	26.22	0.31	1.07	9.61
S-221	96.33	15.53	14.88	63.94	19.94	11.04	32.70	8.37	2.76	3.23	1.96	33.05	0.50	1.47	17.57
S-222	94.83	25.53	24.38	66.94	19.44	12.54	35.70	7.82	2.61	3.22	2.52	62.93	0.60	1.95	38.18
S-223	100.83	17.03	14.38	60.94	16.94	9.04	23.70	7.92	2.86	3.23	2.46	37.09	0.38	1.36	15.34
S-224	95.83	44.03	36.38	68.94	20.44	7.54	22.20	8.02	2.31	3.23	1.69	73.37	0.24	0.96	17.39
S-225	107.83	19.28	16.38	52.69	16.44	11.54	32.70	8.17	2.46	3.22	2.11	40.84	0.17	0.88	8.63
S-226	95.99	16.20	12.71	70.61	19.27	12.04	31.20	8.18	2.59	3.22	2.14	35.90	0.19	0.95	8.45
S-227	108.33	15.20	13.71	52.94	15.94	11.71	27.54	7.82	2.56	3.20	1.90	55.98	0.15	0.99	9.33
S-228	97.33	17.03	13.38	60.94	16.44	12.04	31.20	7.67	2.66	3.20	2.39	31.17	0.22	0.96	8.77
S-229	107.33	13.03	10.38	50.94	13.94	11.04	33.70	7.42	2.56	3.20	2.33	36.19	0.18	1.03	8.07
S-230	94.33	20.53	16.38	63.94	17.94	11.04	34.20	8.17	2.66	3.21	2.49	46.09	0.26	1.16	13.18
S-231	97.83	9.53	7.88	55.44	13.44	10.04	30.70	8.02	2.76	3.21	1.54	28.83	0.14	0.87	6.49
S-232	94.99	16.87	12.38	66.69	18.69	9.71	27.54	7.45	2.62	3.20	2.08	47.09	0.45	2.10	21.78
S-233	98.33	11.53	9.38	57.94	17.94	13.04	25.20	8.12	2.41	3.20	1.93	26.27	0.51	1.71	14.11
S-234	97.66	20.20	16.38	65.94	18.61	11.38	32.87	8.18	2.59	3.20	1.95	27.39	0.38	1.07	10.94
S-235	96.66	12.20	11.38	71.61	17.61	11.38	33.54	8.65	2.66	3.21	2.30	50.42	0.35	1.87	18.23
S-236	104.83	15.03	13.38	37.94	18.94	9.04	26.20	8.72	2.76	3.20	1.97	31.95	0.27	1.10	10.28
S-237	98.83	12.03	9.38	58.44	15.94	8.54	23.70	8.22	2.56	3.20	1.84	34.98	0.18	1.04	8.14
S-238	95.83	15.78	13.38	65.69	18.44	11.54	34.45	8.19	2.58	3.20	2.17	44.31	0.23	1.18	11.62
S-239	95.08	15.53	14.13	75.19	19.94	10.54	28.95	7.72	2.61	3.20	2.26	64.83	0.37	2.05	24.43
S-240	108.99	11.53	9.71	58.94	16.27	10.38	38.20	8.15	2.46	3.20	1.77	36.79	0.25	1.59	10.86
S-241	96.58	13.53	11.13	58.94	17.44	8.54	19.45	7.79	2.68	3.19	1.52	44.35	0.30	1.54	15.15
S-242	97.83	14.03	11.88	77.94	18.94	8.54	24.20	7.82	2.36	3.19	2.08	49.84	0.37	1.88	19.15
S-243	94.33	25.03	15.88	67.94	17.94	10.54	33.70	8.32	2.26	3.20	1.83	64.39	0.36	1.83	23.23
S-244	101.33	9.03	6.38	55.94	14.94	12.54	36.70	8.42	2.46	3.19	1.87	15.89	0.28	1.07	6.82
S-245	102.33	13.03	10.88	65.44	19.94	11.54	25.20	8.17	2.66	3.18	2.38	42.90	0.51	2.23	22.24
S-246	100.66	10.87	10.38	78.61	20.61	10.38	28.20	7.12	2.82	3.16	2.47	34.52	0.58	2.27	20.28
S-247	105.83	17.53	14.63	53.44	13.19	10.04	30.70	7.14	2.73	3.19	2.12	39.25	0.26	1.12	11.77
S-248	100.33	15.03	11.88	65.44	14.44	12.54	24.70	8.52	2.71	3.20	1.93	21.69	0.40	1.09	9.74
S-249	93.83	21.28	20.88	75.94	19.94	8.29	19.45	8.37	2.83	3.20	1.84	85.31	0.19	1.23	15.72
S-250	101.33	15.53	10.88	54.94	13.94	11.04	28.20	7.72	2.41	3.19	2.28	21.36	0.35	1.03	8.62
S-251	102.58	15.78	13.88	64.19	20.69	9.54	24.20	7.69	2.61	3.20	1.93	64.65	0.43	2.30	26.58
S-252	95.33	16.03	13.38	73.44	20.94	10.04	28.20	7.97	2.41	3.20	1.53	36.34	0.53	1.78	19.46
S-253	97.18	11.46	8.48	70.44	15.94	8.47	18.13	8.22	2.72	3.22	1.74	16.49	0.28	0.80	3.21

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-254	106.52	16.13	13.15	53.27	15.94	10.97	33.97	8.38	2.53	3.22	1.83	25.71	0.18	0.57	2.58
S-255	99.68	19.96	15.98	61.94	18.94	8.47	25.63	8.62	2.47	3.22	2.10	61.32	0.17	0.81	8.77
S-256	102.52	13.80	12.15	43.61	15.27	10.31	24.97	8.55	3.07	3.15	1.70	37.94	0.09	0.44	0.95
S-257	105.52	7.13	6.48	37.94	12.94	9.97	31.97	7.98	2.90	3.18	1.69	4.78	0.18	0.39	-1.59
S-258	94.85	28.13	25.15	66.27	17.61	8.97	24.97	8.25	2.60	3.18	1.87	32.90	0.39	0.75	11.63
S-259	105.68	20.96	17.98	51.94	16.94	9.47	27.13	7.92	2.77	3.17	2.07	17.26	0.37	0.61	3.64
S-260	98.68	12.96	10.48	64.44	18.94	11.97	31.63	7.82	2.97	3.17	1.84	26.59	0.30	0.96	7.67
S-261	93.85	19.80	18.15	64.61	18.94	11.31	31.63	7.95	2.60	3.18	1.88	54.15	0.31	1.24	15.19
S-262	103.18	15.46	11.48	53.44	16.94	10.47	33.63	8.22	2.77	3.17	1.92	41.92	0.12	0.64	2.41
S-263	96.68	13.46	9.98	54.94	16.44	11.47	29.13	8.52	2.92	3.18	2.37	35.55	0.26	1.08	7.41
S-264	108.18	25.46	21.98	52.94	13.94	8.47	24.13	7.42	2.52	3.19	1.86	34.34	0.25	0.61	7.01
S-265	97.18	8.46	6.98	65.44	16.44	8.97	26.13	8.32	2.77	3.19	1.97	26.78	0.48	1.89	11.28
S-266	95.18	6.96	5.48	62.94	19.44	9.47	29.13	8.62	2.62	3.18	2.56	21.98	0.38	1.56	6.88
S-267	104.85	13.46	11.48	50.27	13.61	8.64	24.63	8.72	2.77	3.17	1.91	32.33	0.23	1.77	5.28
S-268	98.68	10.46	8.48	53.44	16.94	8.97	25.13	7.47	2.67	3.17	1.74	32.86	0.27	1.22	7.35
S-269	97.18	12.46	10.48	57.44	16.44	9.47	31.63	7.62	2.67	3.17	1.94	26.59	0.54	1.44	11.81
S-270	97.68	32.96	28.48	58.94	18.44	11.47	34.63	7.82	2.97	3.17	2.41	59.62	0.13	0.50	5.35
S-271	93.68	18.46	14.98	60.44	17.44	8.47	22.13	7.92	2.52	3.17	1.81	46.04	0.11	0.55	2.42
S-272	101.18	9.96	7.98	53.94	14.94	8.97	29.13	8.12	2.72	3.16	1.63	12.73	0.20	0.56	0.44
S-273	102.68	20.96	14.98	54.94	16.44	8.97	21.63	8.32	2.77	3.16	1.97	37.56	0.16	0.57	2.94
S-274	100.18	16.46	13.98	59.44	17.44	10.47	30.63	8.52	2.87	3.17	2.07	28.02	0.27	0.78	5.77
S-275	96.68	27.46	21.98	56.94	14.94	11.97	29.13	8.62	2.97	3.17	2.39	26.79	0.38	0.71	8.64
S-276	94.68	16.46	12.23	62.44	17.19	10.72	33.13	8.67	2.72	3.19	1.89	31.95	0.11	0.54	1.14
S-277	102.68	13.96	10.98	58.94	15.94	6.97	21.63	7.52	2.62	3.18	2.33	32.94	0.15	0.74	2.89
S-278	95.68	22.46	18.48	57.44	17.94	8.47	28.13	7.82	2.97	3.17	2.50	39.50	0.11	0.46	2.07
S-279	93.85	14.46	11.48	64.61	17.27	11.31	24.30	7.92	2.40	3.17	2.22	44.13	0.19	0.92	6.27
S-280	103.68	13.46	11.48	63.44	14.94	10.47	24.13	8.17	2.77	3.16	2.17	27.12	0.21	0.70	3.53
S-281	92.85	18.13	13.48	68.61	18.61	11.31	28.63	7.55	2.67	3.16	1.79	37.4	0.11	0.52	2.00
S-282	93.93	10.21	8.73	64.94	17.44	10.22	29.88	7.37	2.52	3.17	1.88	22.87	0.55	1.52	9.62
S-283	95.18	10.96	9.98	67.44	18.19	7.47	22.38	8.24	2.74	3.17	1.67	24.72	0.10	0.47	-0.05
S-284	93.85	13.13	10.82	64.94	16.94	10.97	31.30	8.62	2.67	3.17	1.48	37.50	0.29	1.24	8.90
S-285	98.85	15.80	12.48	54.27	15.27	10.31	28.30	8.32	2.67	3.15	2.22	22.12	0.34	0.93	4.61
S-286	96.52	17.46	14.15	63.27	17.27	8.97	23.63	7.48	2.70	3.15	1.99	31.48	0.12	0.51	1.57
S-287	99.68	13.96	12.48	52.94	15.44	9.97	32.63	7.22	2.62	3.15	2.02	24.31	0.30	0.83	5.52

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
S-288	106.18	15.96	13.98	56.94	14.94	11.47	25.63	8.42	2.87	3.16	1.64	11.17	0.25	0.45	0.85
S-289	96.12	16.43	13.64	69.85	26.85	10.95	35.92	8.34	2.52	3.22	2.23	43.26	0.14	0.73	7.50
S-290	92.62	9.43	7.14	76.35	32.35	8.95	25.42	8.74	2.72	3.21	2.21	31.38	0.34	1.24	11.20
S-291	89.12	10.43	11.14	74.85	29.85	11.45	31.92	8.04	2.77	3.21	1.69	47.57	0.51	1.86	23.80
S-292	89.12	14.43	12.64	83.85	32.35	8.45	20.92	7.99	2.67	3.21	1.78	44.83	0.26	1.33	11.33
S-293	102.62	9.43	7.14	60.85	27.35	8.45	24.92	8.04	2.62	3.21	1.73	15.80	0.16	0.57	4.30
S-294	94.62	15.93	13.39	66.85	27.85	10.45	25.42	8.14	2.92	3.21	1.67	26.51	0.43	3.00	10.84
S-295	91.62	9.43	8.14	68.85	30.35	9.95	27.42	8.44	2.82	3.22	2.41	47.69	0.06	0.67	5.12
S-296	98.62	15.93	11.14	70.35	28.35	9.95	27.42	8.84	2.52	3.23	1.81	39.50	0.18	0.97	8.35
S-297	89.87	14.18	12.89	74.85	29.60	10.70	30.67	8.42	2.74	3.22	1.89	26.78	0.53	1.06	12.27
S-298	104.62	11.43	12.14	59.85	25.35	7.95	24.92	8.09	2.97	3.22	2.00	22.53	0.44	0.91	9.73
S-299	92.12	32.43	28.64	70.35	31.85	9.45	34.92	8.49	2.67	3.23	1.63	47.54	0.18	0.72	10.46
S-300	105.12	6.43	5.14	49.35	24.60	9.95	25.92	8.24	2.64	3.23	1.76	18.46	0.38	1.54	6.43
S-301	93.37	6.93	7.39	63.35	27.10	8.70	22.17	8.54	2.67	3.23	2.22	23.65	0.43	1.10	9.50
S-302	100.62	18.93	16.14	63.85	29.85	10.45	23.92	8.84	2.72	3.22	1.72	22.33	0.41	0.82	9.15
S-303	95.12	8.93	8.47	67.01	27.68	10.62	26.25	8.94	2.63	3.22	1.88	24.54	0.42	1.53	10.22
S-304	96.12	8.43	8.14	68.35	29.35	10.95	31.92	7.84	2.77	3.16	1.80	17.45	0.34	1.01	6.29
S-305	99.12	9.93	8.14	58.35	28.85	8.95	26.92	7.94	2.97	3.17	1.62	23.92	0.18	0.70	5.48
S-306	92.12	17.26	17.47	73.68	31.35	9.95	24.92	7.41	2.43	3.18	2.30	35.42	0.38	0.95	15.33
S-307	91.12	11.93	12.64	74.35	30.35	8.95	27.42	7.64	2.72	3.18	1.59	28.18	0.31	0.84	9.10
S-308	91.12	7.43	5.14	64.85	26.85	11.95	28.92	7.84	2.77	3.19	1.60	19.75	0.27	0.89	5.55
S-309	91.62	16.93	14.64	66.85	30.85	10.95	30.42	8.64	2.67	3.20	1.75	22.16	0.32	0.72	7.43
S-310	94.12	8.93	6.14	60.35	26.85	10.95	26.42	8.69	2.87	3.14	2.25	13.80	0.45	0.70	4.87
S-311	94.37	11.68	10.39	87.35	33.10	10.20	30.67	8.44	2.92	3.14	1.92	28.34	0.08	0.61	4.18
S-312	97.12	4.43	4.64	61.85	27.85	9.95	22.92	8.04	2.57	3.15	1.74	31.82	0.11	1.39	5.00
S-313	98.12	11.43	9.14	55.35	24.35	9.45	23.92	8.04	2.67	3.15	1.93	31.91	0.10	0.65	5.39
S-314	101.12	4.93	4.64	53.85	26.35	8.45	22.92	7.99	2.72	3.16	2.35	38.44	0.06	0.66	4.29
S-315	89.62	16.68	15.14	64.35	28.35	9.70	28.17	8.12	2.62	3.18	2.04	31.01	0.22	0.73	8.13
S-316	92.12	1.93	1.64	80.35	26.85	8.95	19.92	8.24	2.57	3.17	1.43	20.53	0.16	0.88	4.70
S-317	91.62	5.93	5.64	61.35	26.85	9.45	30.92	8.34	2.82	3.15	2.43	28.37	0.17	0.84	6.15
S-318	101.62	14.93	12.14	57.85	26.10	10.45	28.92	8.37	2.64	3.15	2.15	35.20	0.19	0.87	7.96
S-319	104.12	7.68	6.39	46.60	22.85	10.45	29.17	8.84	2.59	3.13	1.70	34.12	0.32	1.56	11.51
S-320	91.62	18.43	17.64	69.35	30.85	10.95	41.92	8.64	2.52	3.05	2.01	21.56	0.37	0.72	8.21
S-321	92.12	7.93	8.14	63.35	27.85	7.45	26.42	7.64	2.97	2.92	1.66	38.57	0.14	0.83	7.15

Genotypes	Days to flowering	No. of total tillers per plant	No. of Panicles per plant	Plant height (cm)	Panicle length (cm)	Primary branches per panicle	Secondary branches per panicle	Grain length (mm)	Grain width (mm)	L/B ratio	100 Grain weight	Biomass (g/plant)	HI	Yield per panicle (g)	Yield per plant (g)
<b>S-322</b>	92.12	17.93	15.64	66.35	28.85	9.20	25.67	7.57	2.79	2.96	1.65	34.32	0.31	0.91	11.40
<b>S-323</b>	100.87	9.93	8.14	60.10	27.85	7.95	25.67	8.39	2.69	3.03	1.84	37.49	0.19	0.95	8.46
<b>S-324</b>	95.87	12.18	9.64	77.10	29.60	7.95	32.92	8.04	2.94	2.83	1.55	37.08	0.22	0.97	9.86
C1 (IR64)	90.44	18.02	15.55	67.19	20.72	9.22	25.66	9.31	2.51	3.18	2.58	52.13	0.39	1.40	20.97
C2 (IR20)	88.22	14.11	14.41	81.69	22.08	9.11	26.61	9.07	2.5	3.17	2.36	47.45	0.49	2.16	25.25
C3 (Shabhagidhan)	85.39	8.31	7.98	84.26	22.41	9.19	26.93	8.59	2.86	3.15	2.51	37.52	0.45	3.02	18.95
C4 (Vandana)	78.63	10.55	9.22	76.72	18.08	9	22.88	8.61	2.925	3.16	2.71	28.95	0.41	1.84	12.77
C5 (F <sub>1</sub> )	93.32	22.96	19.61	66.87	18.55	10.37	29.32	8.07	2.62	3.17	2.49	42.72	0.17	0.45	7.68
C6 (BPT5204)	113.46	19.87	17.83	55.69	16.91	9.83	26.98	7.09	2.30	3.14	1.34	50.24	0.22	0.75	11.04
C7 (IR64Drt1)	88.79	19.38	18.506	76.88	21.35	9.83	24.26	9.40	2.75	3.19	2.71	69.20	0.29	1.33	21.00

(46.60 cm) were too dwarf with respect to very dwarf check BPT-5204 (55.69 cm). Many segregants were in the range of 34.27 cm to 91.30 cm. Overall observations tell that there was reduction in height also diminish the yield (Table 2). However it has been reported that plant height was affected by many factors like plant density, plantation method and fertilizer application [17,18,19].

In this study, most of longer panicles ranged from 7.94 cm to 33.10 cm. The cultivars like S-291 (29.85 cm) was longer panicle with high yield as compared with check Shabhagidhan (22.41 cm). It was concluded that panicle length alone does not determine the high grain yield as traits such as grain size, grain shape, higher number of tillers/plant, long panicles and greater number of grains/panicle ultimately contribute to higher grain yield [20].

The primary branches per panicle varied from 6.97 to 13.19. The highest number of primary branches per panicle with more yield was recorded to the segregants like S-51, S-122, S-135, S-195, S-199, S-210, S-219, S-222, S-251 with respect to check IR-20. While secondary branches per panicle, the highest number was found in the genotypes S-51, S-122, S-135, S-195, S-199, S-210, S-219, S-222. These genotypes were also a good yielder with respect to check IR-20. The secondary branches per panicle varied from 18.13 to 50.53.

In case of the grain length significant differences were observed between the rice segregants however, non-significant differences were recorded for grain width (table 1). The range of grain length occurred from 7.09 mm to 8.96 mm. The longest grain length was observed to the segregants S-16, S-17, S-18, S-33, S-42, S-43, S-63, S-64, S-69, S-85, S-138, S-141, S-185, S-193, S-215, S-235, S-236, S-255, S-266, S-267, S-275, S-276, S-284, S-290, S-296, S-302, S-303, S-309, S-310, S-319 with respect to four checks Shabhagidhan, Vandana, F<sub>1</sub> and BPT-5204. The range of grain length occurred from 7.09 mm to 8.96 mm.

There was significant differences were observed for L/B ratio per plant among the rice segregants (table 1). The range of L/B ratio was 2.83 to 3.27 to the all segregants. There was 107 segregants were high L/B ratio with compared to check IR64Drt1 (3.19).

Higher number of panicles and test weight contributed to higher grain yield (Neelima et al.,

2011). The range of 100 seed weight was 1.34 to 2.56. In this study S-25, S-36, S-175, S-222 cultivars exhibited higher test weight as compared to checks IR20, Shabhagidhan, F<sub>1</sub>, BPT-5204.

There was also significant differences was found between the rice segregants in case of biomass. The highest mean biomass production of population under field condition was recorded in the genotypes S-5, S-7, S-109, S-122, S-135, S-148, S-224, S-249 g/plant as compared to all seven checks. The range of all segregants were 4.78 to 103.32 g /plant.

In this study, the higher HI were recorded for the genotypes S-16, S-33, S-48, S-68, S-111, S-112, S-129, S-130, S-165, S-180, S-187, S-193, S-199, S-219, S-221, S-222, S-246, S-252, S-269, S-291, S-297 with respect to all seven checks.

Grain yield is the ultimate manifestation of a plant's ability to survive, grow and produce more yield under normal field condition. Grain yield of rice under normal field condition differed significantly among rice genotypes (Table 2).

#### 4. CONCLUSION

The present studies suggested the existence of variation among the rice segregants derived from the cross BPT-5204/ IR-64Drt1 for grain yield and their attributes. The results indicated that among 324 rice genotypes, including checks, only 9 rice genotypes (S-51, S-122, S-135, S-195, S-199, S-210, S-219, S-222, S-251) expressed higher yield compared to all checks varieties.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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