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Reciprocal crosses in early maturing x high yielding rice (*Oryza sativa* L.) cultivars

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Abstract
Maximum human food is derived from cereal crop plants which are member of Gramineae family hence, wheat and rice are supplying more than 65% human food requirement for the world population. Reciprocal differences persist in nature because of the unequal involvement of cytoplasmic genes from male and female gametes to the zygote. The inheritance of genetic differences is an important factor that influences various traits, including quality and quantity both in various crops. An experiment was conducted to evaluate the significance differences in between reciprocal crosses of early maturing x high yielding rice cultivars for their genetic control of morphological and yield characteristics. Seven early maturing and four high yielding varieties crossed in reciprocal matting system and produced fifty six F_1's in line x tester fashion. The observations of morphological and yield traits were taken in two different kharif sessions. On the basis of present study, it may be concluded that the significant differences were not exhibited in most of the morphologically and yield characteristics in reciprocal crosses except grain 1000-weight and grain yield per plant rice crop. This study could be helpful in further work in heterosis breeding and hybridization programmes in rice crop improvements.

Keywords: Rice, reciprocal crosses, early maturing and significant difference

Introduction
Food production is one of the most essential matters that currently involved in human society. Foremost human food is derived from cereal plants which are member of Poaceae family so that wheat and rice are supplying more than half human population's food requirement. Rice is a staple food crop that is consumed more than 65% population of the world (Kalyan *et al*., 2017) [3]. Millions of people depend on it as a source of food and income. Thus it requires a continuous improvement in productivity besides profitability in rice farming systems on sustainable basis. Apart from that the yield, food consumption pattern in the recent years encouraged the attention of the grain quality of rice. To meet out the food demand of the growing population and to achieve food security in the country, the present production levels need to be increased by 2 million tones every year, which is possible only through heterosis breeding and other innovative breeding approaches. At the current rate of population growth in India, estimated rice production should be around 135 to 140 million tonnes by 2020. More than 80% daily calorie and 75% required protein is obtained from rice in Asia. So it is critical to produce high yield cultivars with high quality by inbreeding methods (Jondhale *et al*., 2018) [2]. To increase the present levels of heterosis for yield, quality and other traits there is more need to identify and utilize genetically divergent parents for inter and intra sub specific and reciprocal crosses in rice. There are a number of factors of rice production one the most important factor is cytoplasmic gene effect. This effect also known as maternal gene effect. This is more useful in three line hybrid seed production in rice where cytoplasmic genes controlled male sterility. In whole world hybrid rice production depends on cytoplasmic inheritance. Information on the inheritance of polygenic and oligogentic traits is worthful for planning and executing a breeding strategy leading to their genetic improvement. So the identification of maternal effect in reciprocal crosses is also help to identify some traits which are controlled by cytoplasmic genes and useful for development of new high yielding cultivars.

Reciprocal crosses are play an important role in the selection of any breeding programme for population improvement and development of new hybrids in the crop. Both female and male parents contribute some amount of the genes to their offspring, but the influence of female parent often extends beyond simple genetic transmission (Munganyinka *et al.*, 2015) [6]. Shi *et al.* (2000) [9] reported that grain length and width are of the two important quantitative traits those also closely related to the exterior quality of the rice. Genetic analyses of 1000- grain weight, grain yield per plant, length and width of rice kernels have been reported by some of the researchers and most of the studies have shown that rice grain shape is quantitatively inherited (Zhang *et al.,* 2005) [13]. It has been also shown that rice grain shape is controlled by triploid endosperm genes, cytoplasmic genes, and maternal genes (Shi *et al*., 2005) [9] and their genotype into environment interaction effects. The length, width and seed thickness is one of the quantitative measures of grain shape. The objective of the present study was to understand the nature of inheritance of aroma, grain length, grain width, number of spikelets per plant and number of fertile spikelets per plant.
The objectives of this study were to examine the greatness of reciprocal crosses in early maturing x high yielding cultivars of rice. In the present study some traits were studied to identify the inheritance pattern of the particular morphologically and yield related traits through reciprocal crosses. Therefore, the present investigation was undertaken to find out the reciprocal effect in early maturing x high yielding rice cultivars.

Methods and Materials

Seven early maturing and four high yielding elite lines having good plant types with morphological features and yield traits i.e. Anjali, Annada, Govind, HUR 3022, NDR-97, Shanthi, Vandana (seven early maturing) and BPT 5204, HUR 4-3, HUR 105 and MTU 7029 (four high yielding) rice cultivars used for crossing program in reciprocal fashion. Line × Tester mating design during two Kharif session 2011 and 2012 were made at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The resultant F_1s along with their parents were evaluated during two kharif session 2012 & 2013 in Randomized block design with 3 replications. Each entry consists of 2 rows of 3 meters length with a spacing of 20cm between the rows and 15 cm between the plants. Twenty two days old seedlings were transplanted and all the recommended crop management practices were taken up to raise a good and healthy crop. Observations were recorded in 10 plants selected randomly from each cross and parents for all metric traits studied except First panicle emergence, days to 50% flowering, grains per panicle and 1000 seeds weight. First panicle emergence and Days to 50% were computed on the plot basis. Number of Grains per panicle and 1000 grain weight/test weight were computed on the count basis. Observations were recorded on 8morphological/ agronomical and yield traits viz., first panicle emergence, days to 50% flowering, plant height (cm), number of effective tiller per plant, panicle length (cm), number of grains per panicle, 1000-Grain weight (g) and Grain yield per plant (g). The means of reciprocal crosses were compared using Paired t- test at the 5% level after thatthe variances of the data were analyzed by analysis of variance (ANOVA) with Windostate software 13.0.

Results and Discussion

The inheritance study of quantitative characters in reciprocal crosses will help breeders to choose appropriate breeding methods and parents for hybridization programme. Kamara *et al*. (2017) [4] reported the pattern of inheritance of different yield contributing traits and quantitative in rice. Greater variability in the initial breeding material ensures good chances of producing desired forms of a new crop plant. Accordingly to the primary objective of germplasm conservation is to collect and preserve the genetic variability in indigenous collection of crop species to make it available to present and future generations (Kalyan *et al.,* 2017) [3]. The analysis of variance indicated the existence of highly significant differences among genotypes for all the characters were studied (Table 1). Analysis of variance for morphological and yield traits revealed that high significant differences between genotypes and replications, for all the eight traits (Table 1) this indicating a wide range of variability for the all the genotypes. Significant differences among parents were observed for most of the characters many earlier worker also reported that the same type of variations in their studies (Devi *et al*., 2017) [1]. The mean sum of square of morphological and yield traits of early maturing x high yielding rice lines, i.e. first panicle emergence, 50% flowering, plant height, panicle length, effective tillers per plants, and number of grains per panicle, 1000-Grain weight (g) and Grain yield per plant (g) were varied and significantly different among all eleven rice lines (Table 1). The same data of F_1's were taken of fifty six reciprocal crosses and found less divers from their simple crosses with all morphological and yield traits (Table 3).

Days to panicle initiation: A wide range of variability was recorded in parent and F_1's respectively for days to panicle initiation NDR-97 (58.43) showed highly early panicle initiation while BPT 5204 (111.44) exhibited more late than NDR-97 cultivars in parents and F_1' s Annada x HUR 4-3 (72.68) showed earliness followed by Govind x HUR 4-3 (73.50) and hybrid HUR 322 x MTU 7029 (114.82) showed late panicle initiation and followed by HUR 3022 x BPT 5204 (114.12).In the reciprocal crosses of the same parents hybrids in reciprocal fashion showed earliness and late maturity respectively. So these findings showed that there is no maternal gene effects were observed in this trait. This type studies were not found more for all the traits but some researchers also reported the same results in rice crop. Some researchers reported the same types of finding on reciprocal inheritance of the rice.

Days to first panicle emergence: this trait is also involved in earliness and late maturity such as which showed early panicle emergence that mature in early on the other hand which showed late panicle emergence the maturity of that cultivar will be late. In the present experiment range of variability was observed very high for this trait in parents and hybrids. The parent NDR-97 (68.16) showed highly early panicle initiation while BPT 5204 (121.81) exhibited more late than NDR-97 cultivars in parents and F_1's Annada x HUR 4-3 (82.26) showed earliness followed by Govind x HUR 4-3 (82.98) and hybrid HUR 322 x MTU 7029 (120.97) showed late panicle initiation and followed by HUR 3022 x BPT 5204 (123.51). Same pattern followed by in the reciprocal crosses of the same parent's hybrids for earliness and late maturity respectively. In case of earliness of rice reciprocal effects were reported by Devi *et al*. (2017) [1].
Plant height (cm): Study of this trait is very useful for high yield. Plant height mostly showed negative correlation with

yield. It means high plant height produce low yield and vice versa. Range of plant height in parents observed very high from 81.51 cm to 142.88 cm. The smallest parent was found NDR-97 (81.51 cm) and followed that BPT-5204 (84.52 cm) plant height while highest length of plant was observed in parents 142.88 (Vandana) and 139.44 (Anjali) both parents are early maturing cultivars. Range of plant height in F_1's was recorded as 87.54 cm to 146.02 cm HUR 3022 x HUR 4-3 and Vandana x HUR 4-3 respectively showed lowest and highest plant height. Same parents F_1's were also observed highest and lowest plant height in reciprocal cross. It showed hath there is no involvement of cytoplasmic inheritance for this trait in these crosses.

Number of effective tiller per plant: It is an important trait in rice crop that affect directly grain yield or crop production. A wide range of variation was observed in all parents and their F_1's lowest number of effective tillers was 7.77 (Govind) and the highest number of effective tillers were observed 11.22 (MTU 7029) in both the parents. In F1's highest number of effective tillers were funded in Ananda x BPT 5204 (13.78) while lowest number of effective tillers were observed in HUR 3022 x HUR 4-3 (6.76). In case of same parent's reciprocal crosses were not showed lowest and highest numbers of effective tillers such as in others traits. HUR 105 x Shanti (14.14) showed highest numbers of effective tillers while MTU 7029 x Govind (6.87) funded lowest numbers. Maternal gene effects may be responsible for this traits. No more reports are funded on the maternal gene effect or cytoplasmic gene effect for number of effective tillers. Inheritance patterns of some traits such as days to panicle initiation, to 50% flowering number of effective tillers per plant, panicle length and plant height exhibited high genotypic and phenotypic variances, similar results were obtained earlier by Sawant *et al*. (1994) [8] in their study in rice crop.

Panicle length (cm): Panicle length is a yield contributing traits that affect yield directly. Such as large panicle length responsible to produce high yield and vice-vera. It's also observed high variability in the parents as well as F_1's. Range of panicle length in parents from Anjali (26.33 cm) observed highest length while lowest length was funded in NDR-97 (19.78 cm). Hybrids were also showed a wide range of panicle length from Govind x HUR 105 (20.36) lowest panicle length was observed and Anjali x MTU 7029 (30.40 cm) showed highest length of panicle. However, in reciprocal crosses lowest length was observed Annada x BPT 5204 (20.36) and highest length was exhibited by MTU 7029 x Anjali (31.21 cm). In this trait also not fund reciprocal effects.

Number of grains per panicle: It is yield attributing traits that directly affect the yield. It is positively correlated with yield. If numbers of grain per panicle increase or decrease yield also increase and decrease in the same pattern. This trait showed high range of variability in means of parents, hybrids and reciprocal crosses. In parent the lowest number of grains was observed in Annada (91.35) and highest numbers were funded in BPT-5204 (222.57). the range of variation in hybrid also observed lowest number of grains observed in NDR-97 x HUR 4-3 (96.45) and in reciprocal crosses the same parents hybrid showed lowest number of grains HUR 4-3 x NDR-97 (106.49). Highest number of grains per panicle was observed in the hybrid of simple cross Shanthi x BPT 5204 (203.14) and in reciprocal cross BPT 5204 x Annada (206.85). This trait also showed reciprocal difference significantly.

1000-Grain weight (g): It is also known as test weight. This traits is another yield contributing trait which positively correlated with yield. 1000-grain weight (g.) is also showed a wide range of variability in parental lines, hybrids as well as in reciprocal crosses. The range of variation obtained for 1000-grain weight in parental lines BPT 5204 (18.25 g) showed lowest weight while HUR 105 (22.70 g) highest 1000- grain weight. In hybrid Shanti x BPT 5204 (19.10 g) observed lowest grain weight whereas Anjali x HUR 105 (27.71 g) showed highest 1000-grain weight. In reciprocal crosses wide range of variation also obtained but same parents involved in lowest and highest grain weight hybrids BPT 5204 x Shanthi (19.00 g) and HUR 105 x Anjali (26.51 g). So, in this traits maternal effect was founded and some other workers also reported the same findings. Quantitative traits highly influenced by the environmental and this factor create confusion on the inheritance pattern of the trait.

Grain yield per plant (g): it is the ultimate goal of a plant breeder to breed a new genotype for high yielding and good quality. This trait showed significant difference in reciprocal crosses. It is a quantitative traits that affect a number of other yielding traits such as, panicle length, no of grain per panicle, test weight and filled grains per panicale etc. A wide range of variation in all parents as well as hybrids with their reciprocals were observed for grain yield per plants. The range of grain yield per plant Govind showed (18.47 g) lowest grain yield per plant whereas BPT 5204 (33.45 g) produced highest grain yield per plant near to double of the lowest parent yield. On the other hand Annada x MTU 7029 (35.71 g) simple crosses exhibited highest grain yield in all 56 crosses (Direct and reciprocal crosses) and HUR 3022 x HUR 4-3 (17.63 g) showed lowest grain yield per plant. The parent MTU 7029 (31.16 g) also high yielding parent that showed send highest grain yield in all the parents. In reciprocal crosses HUR 3022 x HUR 105 (20.15 g) showed lowest yield while Annada x BPT 5204 (34.44 g). Among the various options for increasing rice production, earliness and high yielding both traits are priority in any breeding program that have to be proved to the best strategies and it has tremendous scope in Indian agriculture (Thirugnanakumar *et al.*, 2011) [11]. There is more need to develop short duration cultivars with good quality and high yielding capacity to fulfillment the future demand of food grain. This wide-ranging variation showed for all the morphological characters and yield high diversed parents (Table 2 and 3).

Conclusion
On the basis of findings it may concluded that the most of traits were exhibited non-significant differences in reciprocal crosses except 1000-grain weight and yield per plant in these crosses. It showed that these two traits 1000 grain weight and grain yield maybe influenced with cytoplasmic inheritance. These also having some influenced due to environmental because both are quantitative or polygenic controlled. Improving rice production through cross breeding is one of the best efforts to overcome a major challenge in future need of rice consumers. So reciprocal crosses may help to achieve the target of production. Maternal inheritance is an especial tool for developing high yielding and ideal plant types in rice crop.

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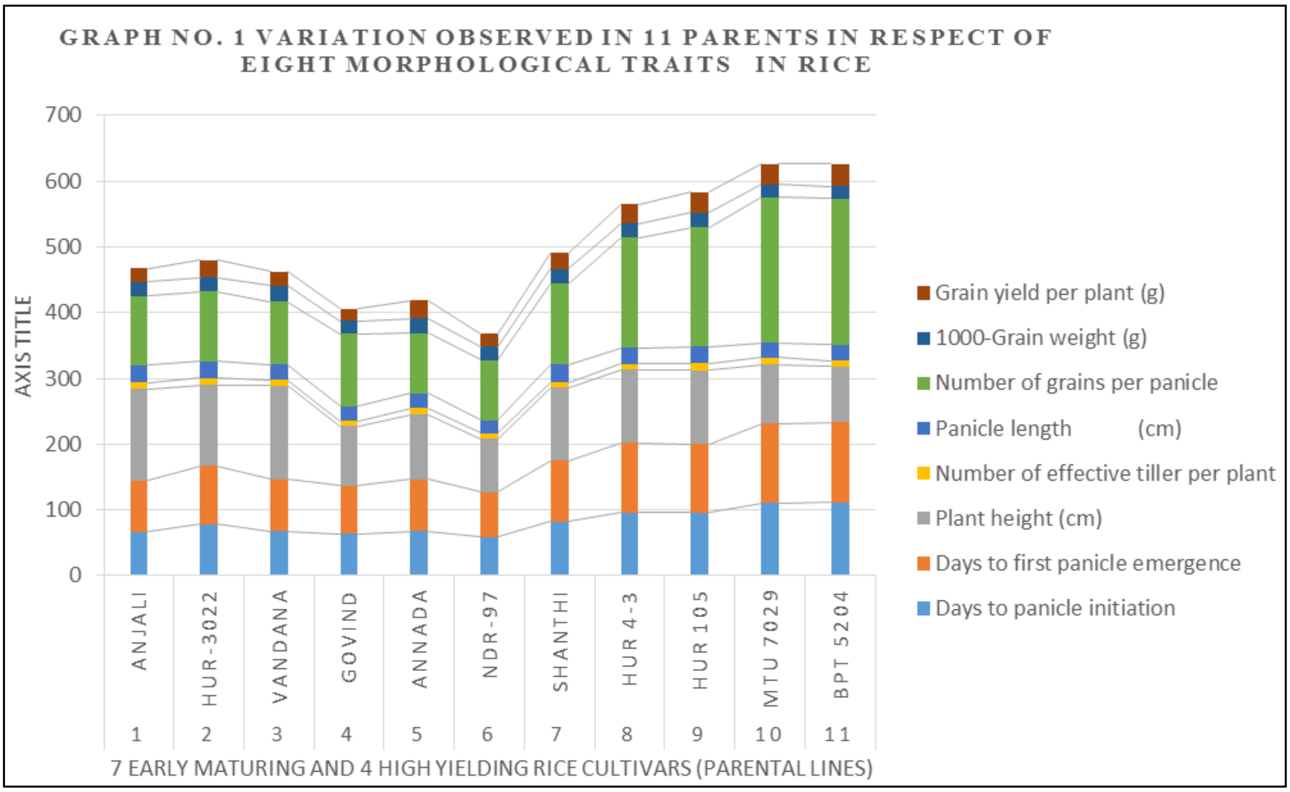

Table 1: Anova for L X T analysis for eight morphological characters in rice (Mean sum of square)

Source of Variations	d.f.	Days to panicle initiation	Days to first panicle emergence	Plant height (cm)	Number of effective tiller per plant	Panicle length (cm)	Number of grains per panicle	1000-Grain weight (g)	Grain yield per plant (g)
Replicates	2	0.2276	2.9131	0.5034	0.2166	0.2895	9.8276	1.1752	0.1068
Treatments	38	767.4430**	748.4891**	938.8356**	9.1161**	20.7873**	4585.8496**	13.3453**	76.5403**
Parents	10	1088.5101**	1032.0524**	1338.6814**	3.4231**	13.3857**	7705.3521**	9.6752**	82.1836**
Parents (Line)	6	204.2718**	209.5583**	1707.3846**	2.7165**	20.2675**	383.7927**	8.1016**	37.4712**
Parents (Testers)	3	229.1948**	234.2984**	612.6906**	4.0201**	3.9266	2201.8105**	10.4074**	8.0630**
Parents (L vs T)	1	8971.8867**	8360.2783**	1304.4341**	5.8721**	0.4718	68145.3359**	16.9210**	572.8197**
Parents vs Crosses	1	1653.9303**	1643.1841**	694.6251**	36.3067**	80.2099**	7881.7378**	30.1502**	160.2147**
Crosses	27	615.6964**	610.3289**	799.7894**	10.2175**	21.3279**	3308.4087**	14.0821**	71.3511**
Line Effect	6	1690.0707**	1645.5802**	2606.7544**	10.8835	22.3859	2364.6775	6.6396	121.9580**
Tester Effect	3	500.2650	513.6456	460.3897	27.6526*	58.6098*	13507.3320**	71.3902**	87.1246**
Line * Tester Eff.	18	276.8101**	281.3590**	254.0344**	7.0896**	14.7616**	1923.1650**	7.0117**	51.8532**
Error	76	1.0807	1.1661	1.7656	0.5492	1.0468	4.9476	0.9082	1.4929
Total	116	252.1157	246.0089	308.7151	3.3499	7.5005	1505.6721	4.9870	26.0535

*, ** = Significant at 5 % and 1 % level respectively

Table 2: Mean performance of parents in respect of eight morphological traits in rice

S. No.	Genotype	Days to panicle initiation	Days to first panicle emergence	Plant height (cm)	Number of effective tiller per plant	Panicle length (cm)	Number of grains per panicle	1000-Grain weight (g)	Grain yield per plant (g)
1.	Anjali	66.80	77.95	139.44	9.89	26.33	104.90	21.74	20.55
2.	HUR-3022	78.48	88.41	123.20	10.05	25.27	106.27	21.34	26.38
3.	Vandana	67.87	78.33	142.88	8.560	23.23	95.67	24.49	21.24
4.	Govind	63.29	73.80	90.63	7.77	22.50	109.97	19.44	18.47
5.	Annada	67.99	78.84	97.83	10.26	22.35	91.35	22.66	27.35
6.	NDR-97	58.43	68.16	81.59	8.66	19.78	91.65	20.43	19.18
7.	Shanthi	81.95	92.73	110.87	8.56	27.22	122.67	22.53	24.42
8.	HUR 4-3	96.13	106.03	111.28	8.75	24.31	167.79	20.60	29.63
9.	HUR 105	95.83	104.38	111.77	10.67	25.25	181.67	22.70	30.45
10.	MTU 7029	110.74	120.56	89.55	11.22	22.50	220.46	19.72	31.16
11.	BPT 5204	111.44	121.81	84.52	9.29	24.18	222.57	18.25	33.45
	Mean	**81.72**	**91.91**	**107.60**	**9.43**	**23.90**	**137.72**	**21.26**	**25.66**
	SEd±	0.608	0.625	0.773	0.418	0.589	1.272	0.568	0.693
	CD (0.05)	1.711	1.758	2.175	1.176	1.657	3.580	1.597	1.951

Table 3: Mean performance of parents and hybrids (direct and reciprocal) in respect of yield, yield attributes and quality traits in rice

S. No.	Name of crosses	Days to panicle initiation		Days to first panicle emergence		Plant height (cm)		Number of effective tiller/plant	
		DC	RC	DC	RC	DC	RC	DC	RC
1.	Anjali x HUR 4-3	106.10	105.34	116.59	115.08	131.65	130.47	10.84	11.35
2.	Anjali x HUR 105	97.41	96.47	109.72	107.30	132.86	135.23	10.22	11.02
3.	Anjali x MTU 7029	81.55	82.64	91.84	91.44	132.07	132.79	13.20	11.75
4.	Anjali x BPT 5204	99.18	99.11	109.65	108.33	121.07	120.91	10.41	8.78
5.	HUR 3022 x HUR 4-3	79.72	80.19	89.62	90.04	87.54	86.62	6.78	7.23
6.	HUR 3022 x HUR 105	110.75	110.81	120.57	120.51	122.55	120.24	10.47	12.24
7.	HUR-3022 x MTU 7029	114.82	115.49	123.51	124.38	120.18	119.90	8.75	10.24
8.	HUR 3022 x BPT 5204	114.12	114.42	121.97	123.29	100.65	101.13	12.31	13.98
9.	Vandana x HUR 4-3	86.03	86.35	97.56	96.79	146.02	147.93	11.31	13.57
10.	Vandana x HUR 105	74.72	75.25	83.37	84.53	137.27	135.29	12.71	11.12
11.	Vandana x MTU 7029	80.10	80.64	90.28	89.64	142.69	144.02	7.86	8.89
12.	Vandana x BPT 5204	83.60	83.49	94.02	92.94	120.85	121.02	10.83	9.48
13.	Govind x HUR 4-3	73.50	73.40	82.98	82.61	105.38	105.00	8.35	9.78
14.	Govind x HUR 105	74.69	74.15	85.12	83.53	100.53	100.41	11.57	13.21
15.	Govind x MTU 7029	77.25	77.63	88.39	87.07	91.39	92.62	7.97	6.87
16.	Govind x BPT 5204	77.46	77.44	87.37	87.20	98.66	98.41	11.43	10.67
17.	Annada x HUR 4-3	72.68	72.29	82.26	81.79	96.69	96.88	11.04	11.15
18.	Annada x HUR 105	98.83	98.49	108.81	108.63	103.20	99.43	11.72	14.09
19.	Annada x MTU 7029	107.37	107.34	116.68	116.67	107.96	108.00	9.08	8.70
20.	Annada x BPT 5204	104.36	105.27	115.55	114.32	101.43	102.22	13.78	12.26
21.	NDR 97 x HUR 4-3	73.66	73.41	82.50	82.67	98.52	98.19	9.01	7.57
22.	NDR 97 x HUR 105	74.34	74.16	85.20	83.62	108.68	109.80	11.20	10.77
23.	NDR 97 x MTU 7029	81.37	82.44	90.81	91.81	96.62	96.81	7.42	6.65
24.	NDR 97 x BPT 5204	78.43	78.77	88.66	88.01	102.27	101.77	11.85	11.69
25.	Shanthi x HUR 4-3	91.46	91.37	100.85	100.42	115.39	114.54	12.44	10.00
26.	Shanthi x HUR 105	100.63	101.55	110.39	110.79	129.88	129.20	12.08	14.14
27.	Shanthi x MTU 7029	102.19	102.81	112.48	111.68	100.82	104.17	11.75	10.87
28.	Shanthi x BPT 5204	105.90	105.35	116.28	114.92	111.54	114.40	12.23	12.07
	Mean	90.08	90.22	100.11	99.64	113.01	113.12	10.66	10.72
	t-value (Paired t-test)	1.335		2.015		0.114		2.015	
	SD	14.33	14.35	16.33	16.48	2.15	2.15	1.85	1.85

Table 3 Contd….

S. No.	Name of crosses	Panicle length (cm)		Number of grains per panicle		1000-Grain weight (g)		Grain yield per plant (g)	
		DC	RC	DR	RC	DR	RC	DC	RC
1.	Anjali x HUR 4-3	27.50	28.36	134.76	133.16	21.99	21.20	32.24	31.45
2.	Anjali x HUR 105	28.40	29.11	160.13	145.20	27.71	26.51	27.36	26.66
3.	Anjali x MTU 7029	30.40	31.21	180.96	203.87	24.58	22.54	34.70	33.33
4.	Anjali x BPT 5204	27.26	28.45	188.12	154.11	21.10	19.33	33.56	34.05
5.	HUR 3022 x HUR 4-3	22.28	22.24	136.75	135.01	21.81	21.52	17.63	20.15
6.	HUR 3022 x HUR 105	26.57	26.30	142.80	143.07	24.41	25.26	28.57	25.25
7.	HUR-3022 x MTU 7029	28.34	25.65	136.41	167.84	20.85	21.14	29.95	28.84
8.	HUR 3022 x BPT 5204	26.60	26.89	130.68	142.34	19.90	19.38	30.29	29.12
9.	Vandana x HUR 4-3	21.22	25.23	166.10	169.88	22.19	21.66	30.63	28.87

10.	Vandana x HUR 105	27.12	24.15	157.74	157.79	21.27	24.08	25.61	26.11
11.	Vandana x MTU 7029	26.08	22.50	190.19	125.59	22.77	23.76	30.19	29.36
12.	Vandana x BPT 5204	25.43	27.47	158.46	195.40	20.84	20.59	32.72	30.65
13.	Govind x HUR 4-3	25.24	25.33	100.84	119.10	22.53	22.59	20.23	22.14
14.	Govind x HUR 105	20.36	22.65	153.49	156.69	23.56	23.85	29.38	27.75
15.	Govind x MTU 7029	27.42	24.47	187.95	188.31	24.60	22.54	18.71	20.22
16.	Govind x BPT 5204	28.35	27.15	200.25	175.97	20.84	20.92	24.48	23.52
17.	Annada x HUR 4-3	26.21	23.33	109.43	125.80	22.16	22.22	24.96	22.35
18.	Annada x HUR 105	22.50	23.30	192.86	175.41	25.43	24.97	31.29	29.10
19.	Annada x MTU 7029	26.20	26.84	182.87	117.68	22.15	22.56	35.71	33.50
20.	Annada x BPT 5204	22.27	22.17	199.85	206.85	19.27	19.70	35.39	34.44
21.	NDR 97 x HUR 4-3	23.06	25.41	96.45	106.49	24.35	23.95	31.65	29.90
22.	NDR 97 x HUR 105	23.31	22.50	142.63	143.18	23.64	23.31	26.06	26.56
23.	NDR 97 x MTU 7029	25.25	24.31	119.58	129.98	20.42	21.37	31.54	30.23
24.	NDR 97 x BPT 5204	26.57	27.53	204.93	171.29	19.83	19.77	23.32	24.25
25.	Shanthi x HUR 4-3	25.04	26.53	110.96	114.13	20.23	24.13	21.22	20.21
26.	Shanthi x HUR 105	29.12	29.15	146.96	146.52	26.28	26.93	27.35	25.55
27.	Shanthi x MTU 7029	29.45	28.30	127.21	131.52	23.25	23.36	28.33	27.47
28.	Shanthi x BPT 5204	28.22	28.73	203.14	202.43	19.10	19.00	28.37	28.88
	Mean	25.92	25.90	155.80	153.02	22.40	22.43	28.27	27.50
	t-value (Paired t-test)	0.053		0.693		1.091		1.026	
	SD	2.61	2.49	28.88	34.02	2.16	2.13	4.87	12.33

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