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STUDIES ON THE F_2 GENERATION OF INTER-VARIETAL CROSSES IN RICE*

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Rice is the foremost cereal crop of the world and concentrated efforts are being made to increase the production of this staple food. Introduced varieties though highly productive often fail to establish themselves, because of their unsuitability to the local environment. The most important factors which limit the performance of indica varieties are the tall lodging nature of the plant and their poor fertility response. So genetic improvement of local types is the best way for getting high yielding rice varieties. The richness of varietal diversity in cultivated rice and the easy crossability among them have helped in the development of a large number of improved strains through intervarietal hybridization.

!n the present investigation, the parents are selected with wide range of objectives. Ptb23 and Ptb29 are improved dryland strains in Kerala and Navara is a local medicinal variety with short duration. These varieties are having good rice quality and adaptability, but have low yield. Annapurna and Triveni are used as donors for high yield potential.

Ptb 28 is crossed with Annapurna and Triveni, Ptb 29 with Triveni, and Navara with Annapurna and the performances of the F_2 of these four crosses are studied in comparison with their parents to obtain the pattern of inheritance of characters, and the relationship of some of the important characters with yield in the segregating population of the intervarietal crosses.

Materials and Methods

Selfed seeds collected from F_1 plants of the inter-vatietal crosses, Annapurna x Navara, Annapurna x Ptb 28, Triveni x Ptb 23 and Triveni x Ptb 29 available in the Department of Botany, College of Agriculture, Vellayani were utilized for this study. Five hundred seeds from the F_1 plants of each cross and 50 seeds from each of the five parents were sown separately in pots at the rate of 3 seeds per pot. The two wetland parental varieties namely Triveni and Annapurna were grown in wetland condition and all others under dryland condition. The usual manuring and plant protection schedules recommended for paddy were adopted. The field experiment was completed by June, 1973.

Observations on the characters namely plant height, number of tillers, number of productive tillers, time to flowering, panicle length, weight of panicle, spikelet

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sterility, grain yield and weight of grain were recorded. Plant height was measured in cm from the base of the plant to the tip of the tallest panicle at maturation. Number of tillers per plant was counted at the time of maturity and total number of ear bearing tillers per plant was counted at the time of harvest. Number of days taken from the date of sowing to the opening of the first spikelet in the first emerging panicle was recorded as the time to flowering and length of the panicle of the main shoot was measured as the panicle length. For weight of panicle, weight in g of panicles of the main shoot was recorded. The study of spikelet sterility was confined to the main panicles. Fully matured panicle was scissored off, and well filled grains and chaff were counted for each panicle and the percentage of sterility was estimated. For estimating the grain yield, individual plants were harvested and seeds collected separately and weighed. In the observation of weight of grain, samples were drawn at random from each plant and 1000 grain weight was recorded. For all the characters the mean, standard error and coefficient of variation were found out. Correlation studies of height, number of tillers, panicle length and weight of 1000 grains on yield were also completed.

Results and Discussion

The results obtained for plant height reveal that this is inherited as a polygenic character. Continuous variation in F_2, transgressive segregation, a general agreement of the F_2 mean with mean of the parents, a wider range of variability in the F_2 etc. observed in all crosses support the above view. The effect of a large number of genes with many modifier complexes are implied in the pattern of segregation. This is in agreement with the findings of Chalam and Venketeswarlu (1965), Sastry (1966) and Chang (1965).

The four parents possess varying potentialities for the production of tillers which lead to the assumption that the parents have varying number of contributing genes for the production of tillers. A comparison of the F_2 means of the crosses Annapurna x Navara and Annapurna x Ptb 28, where Annapurna is common in both, indicates that the mean value is more in the former. This may be due to the greater number of genes contributed by Navara when compared to those of Ptb 28. The same explanation holds good in the comparison of F_2 means of two other crosses, Triveni x Ptb 28 and Triveni x Ptb 29, where Triveni is common to both (Table 1).

The number of productive tillers also shows the same pattern. Eventhough the earbearing tillers produced are within the respective parental means they appear to be nearer to the female parent (Table 2) which suggests the matroclinous nature of inheritance which is in accordance with the report by Wu (1968). The results in general indicate that a good proportion of F_2 population in all the crosses surpasses the mean of higher tiller producing parent which makes available suitable 'panicle number type' segregants which are generally high yielding ones.

Table 1

Frequency distribution of individuals (parents and F_2) for total number of tillers

Class value / Particulars	7	13	19	25	31	37	43	43	55	Total	X	SE	C V
Navara	16	19	12	3	—	—	—	—	—	50	13.2	0.770	40.91
Ptb 29	10	27	12	1	—	—	—	—	—	50	13.5	0.585	30.37
Ptb 28	34	15	1	—	—	—	—	—	—	50	9.0	0.457	35.55
Annapurna	10	21	10	7	2	—	—	—	—	50	15.4	0.914	41.55
Triveni	2	15	28	5	—	—	—	—	—	50	17.7	0.228	9.04
Annapurna x Navara	27	95	163	93	60	18	6	4	2	468	21.2	0.388	3962
Annapurna x Ptb28	57	183	158	67	23	6	2	—	—	496	17.1	0,296	38,59
Triveni x Ptb 28	83	242	133	29	3	3	—	—	—	493	14.6	0.234	36.30
Triveni x Ptb 29	66	195	123	41	10	—	—	—	—	435	15.3	0.240	32.68

x = Arithmetic mean SE= Standard error of mean CV= Coefficient of variation

Table 2

Frequency distribution of individuals (parents and F_2) for number of productive tillers

Class value / Particulars	5	11	17	23	29	35	41	47	Total	X	S E	C V
Navara	17	22	11	—	—	—	—	—	50	10.3	0.686	46.6
Ptb 29	23	20	7	—	—	—	—	—	50	9.1	0.586	45.1
Ptb 28	33	16	1	—	—	—	—	—	50	7.2	0.429	41.6
Annapurna	10	22	16	2	—	—	—	—	50	12.0	0.714	41.9
Triveni	21	21	7	1	—	—	—	—	50	9.6	0.600	43.7
Annapurna x Navara	46	143	161	75	21	8	3	2	459	16.1	0.322	42.8
Annapurnax Ptb 28	95	255	116	19	2	—	—	—	487	11.8	0.194	36.4
Triveni x Ptb 28	144	262	66	10	—	—	—	—	482	10.3	0.182	38.8
Triveni x Ptb 29	152	225	33	12	—	—	—	—	422	9.6	0.200	44.8

x = Arithmetic mean SE = Standard error of mean CV = Coefficient of variation

Table 3

Frequency distribution of individuals (parents and F_2) for time to flowering in days

Class value / Particulars	51.5	58.5	65.5	72.5	79.5	86.5	93.5	100.5	107.5	Total	X	SE	CV
Navara	37	9	4	—	—	—	—	—	—	50	53.8	0,742	9.66
Ptb 29	—	—	—	2	43	5		-	—	50	79.9	0,443	3.88
Ptb 28	—	—	1	29	20	—	—	—	—	50	75.2	0.385	3.59
Annapurna	—	4	44	2	—	—	—	—	—	50	65.2	0.414	4.44
Triveni	—	—	35	15					—	50	67.6	0.643	6,65
Annapurna x Navara	165	81	63	55	61	6	4	1	—	436	62.3	0.622	20.86
Annapurna x Ptb 28	—	41	76	236	113	17	3	1	—	487	72.6	0,343	10.60
Triveni x Ptb 28	—	2	43	242	178	9	—	—	—	474	74.7	0.215	6.31
Triveni x Ptb 29	51	85	72	125	78	27	23	—	—	461	69.6	0.507	15.66

X = Arithmetic mean SE = Standard error of mean C V = Coefficient of variation

Table 4

Frequency distribution of individuals (parents and F_2) for panicle weight in g

Class value / Particulars	51.5	1.45	2.05	2.65	3.25	3.85	4.45	5.05	Total	X	S E	C V
Navara	8	35	7	—	—	—	—	—	50	1.43	0.022	25.2
Ptb 29	—	30	20	—	—	—	—	—	50	1.69	0.018	17.1
Ptb 28	—	—	17	20	9	4	—	—	50	2.65	0.035	20.7
Annapurna	—	22	22	6	—	—	—	—	50	1.86	0.025	21.0
Triveni	—	—	—	11	23	10	G	1	50	3.33	0,038	17.7
Annapurna x Navara	98	99	42	8	3	—	—	—	250	1.38	0.032	37.0
Annapurna x Ptb 28	22	51	87	59	21	9	1	—	250	2.13	0.047	35.2
Triveni x Ptb 28	5	25	62	80	45	25	6	2	250	2,63	0.051	31.2
Triveni x Ptb 29	41	62	98	32	17	—	—	—	250	1.86	0.042	36,0

X = Arithmetic mean S E = Standard error of mean C V = Coefficient of variation

Table 5

Frequency distribution of individuals (parents and F_2) for grain yield in g

Class value / Particulars	7.5	13.5	19.5	25.5	31.5	37.5	43,5	49.5	55.5	Total	X	SE	CV
Navara	20	22	5	3	—	—	—		—	50	12.4	0.714	40.2
Ptb 29	20	21	8	1	—	—	—		—	50	12.3	0.657	37.4
Ptb 28	7	17	21	5	–	—	—		—	50	16.3	0.828	35.5
Annapurna	5	13	21	8	3	—	—		—	EO	18.4	0.871	33.1
Triveni	—	—	14	11	15	—.	—		—	50	28.4	1.014	25.4
Annapurna x Navara	94	158	106	46	30	9	2	3	3	449	17,0	0.387	48.1
Annapurna x Ptb 28	49	108	144	92	53	20	8	3	1	458	21.7	0.360	35.4
Triveni x Ptb 28	58	106	125	87	54	16	7	7	3	463	20.8	0.442	45.6
Triveni x Ptb 29	98	195	75	28	10	4	2	—	—	412	14.8	0.315	43.2

X = Arithmetic mean S E = Standard error of mean C V = Coefficient of variation

Table 6

Frequency distribution of individuals (parents and F_2) for spikelet sterility in per cent

Class value / Particulars	5.5	15.5	25.5	35.5	45.5	55.5	65.5	75.5	85.5	Total	X	S E	C V
Navara	23	16	9	2	—	—	—	—	—	50	03.5	1.243	64.4
Ptb 29	30	18	2	—	—	—	—	—	—	50	9.9	0.814	57.5
Ptb 28	23	17	10	—	—	—	—	—	—	50	12.9	1.100	59.7
Annapurna	26	19	5	—	—	—	—	—	—	50	11.3	0.955	59.3
Triveni	20	25	5	—	—	—	—	—	—	50	12.5	0.885	49.6
Annapurna x Navara	32	90	103	77	57	30	25	13	21	443	34.8	0.968	58.9
Annapurna x Ptb 28	157	190	67	32	22	4	3	3	5	483	22,2	0.481	47.7
Triveni x Ptb 28	238	151	53	23	14	1	1	1	4	486	14.4	0.572	87.5
Triveni x Ptb 29	102	129	80	47	31	13	10	8	7	427	24.0	0.888	76.2

X= Arithmetic mean SE = Standard error of mean C V = Coefficient of variation

Table 7

Frequency distribution of individuals (parents and F_2) for weight of 1000 grains in g

Class value / Particulars	15.5	17.5	19.5	21.5	23.5	25.5	27.5	29.5	31.5	Total	X	SE	CV
Navara	8	16	18	3	5	—	—	—	—	50	22.7	0.371	11.4
Ptb 29	—	—	—	7	18	15	10	—	—	50	28.6	0.314	7.6
Ptb 28	—	—	—	—	9	35	6	—	—	50	29.4	0.014	0.003
Annapurna	—	—	—	—	8	18	18	3	3	50	30.5	0 300	6.9
Triveni	—	—	—	2	11	25	12	—	—	50	29.4	0.157	3.7
Annapurna x Navara	10	11	38	51	82	43	12	3	—	250	26.5	0.183	10.9
Annapurna x Ptb 28	9	3	8	13	51	86	48	21	11	250	29.2	0.215	11.6
Triveni x Ptb 28	—	—	3	19	75	90	48	15	—	250	29.1	0.171	9.3
Triveni x Ptb 29	—	—	8	22	80	50	62	28	—	250	29.3	0.133	7 1

X = Arithmetic mean S E = Standard error of means C V = Coefficent of variation

The results of inheritance of time to flowering suggest a polygenic nature for this trait and the F_2 frequencies are distributed within the mean values of the two parents (Table 3). This is in support of earlier findings reported by Ramiah (1933) and Nagai (1959). In the cross Annapurna x Navara, an accumulation of frequency towards earliness is seen in F_2 resulting in a skewed distribution. This may be due to the fact that the qualifying values of the genes may not be the same as reported by Nagai (1959). The results, in general, indicate scope for selection of early flowering types.

Yield is a complex character conditioned by a number of components including panicle number, panicle length etc. Panicle number and panicle length are inherited as quantitative traits controlled by many genes. This is in accordance with the statements of Nagai (1959) that many of the hybrids between long and short ear types demonstrate in F_2, a continuous variation extending over the range of the parents. Panicle weight also is seen to be governed by multiple genes. (Table 4). Yield is also inherited as a quantitative trait controlled by polygenes. In the crosses Annapurna x Navara, Annapurna x Ptb 28 and Triveni x Ptb 28, about 4,5, 7.5 and 2.5 per cent respectively of F_2 segregants surpass the higher parental limit in their mean yield (Table 5). This suggests the potentiality of the segregants under study.

The results of spikelet sterility (Table 6) recorded segregants ranging from almost complete fertility to almost complete sterility in the F_2 which may be due to partial break down of the F_1 as suggested by Oka (1964). The pattern of distribution of 1000 grain weight suggests the presence of many genes in the determination of this character (Table 7), Chandraratna and Sakai(1960) also have arrived at the same conclusion that grain weight is a polygenic character. No significant correlation was observed between yield and plant height, number of tillers, panicle length and 1000 grain weight.

Summary

In the study of the F_2 generation of the cross of two improved dryland strains and a local medicinal variety of rice with two high yielding varieties revealed that all the characters under observation were inherited polygenically. F_2 segregants surpassing the higher parental limit in their mean yield were obtained. No significant correlation was observed between yield and plant height, number of tillers, panicle length and 1000 grain weight.

സംഗ്രഹം

നെല്ലിന്റെ, രണ്ട് അഭിവൃദ്ധിപ്പെട്ട വരൾഭൂമിജനുസ്സും, ഒരു നാടൻ ഔഷധ ഇനവും, രണ്ട് അത്യുൽപ്പാദനശേഷിയുള്ള ഇനങ്ങളുമായി സങ്കരണം ചെയ്ത രണ്ടാം സങ്കരതലമുറയുടെ പഠനത്തിൽനിന്നും, നിരീക്ഷണത്തിനു വിധേയമായ 9 സ്വഭാവഗുണങ്ങൾ, പരിണാ

ത്മക വംശാഗതി കാണിക്കുന്നതായി മനസ്സിലായി. പൈതൃക തലമുറയേക്കാൾ വിളവു കൂടുതലുള്ള ചെടികൾ രണ്ടാം സങ്കര തലമുറയിൽ കാണുകയുണ്ടായി. ചെടിയുടെ ഉയരം, ചിനപ്പുകളുടെ എണ്ണം, കതിരിന്റെ നീളം, 1000 നെൽമണിയുടെ തൂക്കം എന്നീ സ്വഭാവഗുണങ്ങളും തമ്മിൽ ഗണനീയമായ സഹബന്ധം കാണുകയുണ്ടായില്ല.

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