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Estimation of Selection Gain in Early Segregating Generations (F_2 and F_3) of Rice (*Oryza sativa* L.) for Protein and Yield Content

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A B S T R A C T

Handling of segregating populations, especially in early generation is a tricky issue. Due to segregation, identification of desirable plant types is quite difficult and at the same time, there are chances of losing them. The aim of this study was to determine selection gain and selection intensity for high yield *i.e.* to estimate the genetic potential transferred from F_2 generation to F_3 generation by using a total of 200 progenies were studied in F_3 generation during *kharif*, 2014. All the 200 entries belonging to four selected rice crosses viz. Suraksha x Jalanidhi, Suraksha x RP Bio-226, Suraksha x Phalguna and Suraksha x Mahamaya, were sown separately on 4th July, 2014. The analysis of these early generation selection data was done to estimate selection intensity and selection gain for 200 rice progenies. Highest selection intensity was observed for the crosses Suraksha x RP Bio-226andSuraksha x Jalanidhi, whereas lowest selection intensity was observed for the cross Suraksha x Mahamaya. When comparing selection intensity in between F_2 and F_3, generations it was increased for all crosses studied in the experiment, indicating that the selections were progressed towards yield improvement. Selection gain is greater than the expected mean yield in F_3 generation for the cross Suraksha x Phalguna and Suraksha x Mahamaya *i.e.*, increased for both crosses in next generation, indicating that selection is effective for grain yield. Selection gain is lower than expected mean yield for the cross Suraksha x Jalanidhi, Suraksha x RP Bio-226 i.e., decreased for both crosses in next generation, indicating that selection is ineffective for grain yield.

Introduction

Rice is life and prince among cereals. This unique grain helps sustain two thirds of world's population. Rice is the backbone of India's economy providing direct employment to about 70 per cent working people in the country. Asia is the biggest rice producer, accounting for 90 per cent of the world's production and consumption of rice. (Anon., 2007). It is considered as the main staple food for more than50 per cent of the world's population (Child, 2004). Globally, India ranks first in area, 43.6 million ha and second in production 91.7 million tonnes with productivity of 2811 Kg ha^{-1} [Amrit Patel, 2008]. Crop improvement for grain yield has been achieved in rice through effective use of

F2 and F3 segregating populations and fixing desirable character combinations. However, there are still possibilities to increase the yield output through proper breeding technologies in rice. Grain yield is a complex trait and is the result of interaction of many variables. Estimation of selection gain and selection intensity is one of the methods used for genetic potential transferred from one segregating generations for particular character. The present investigation was undertaken to evaluate how far the genetic potential is transferred from F_2 and F_3, based on selection for single plant yield in F_2 (Anil Kumar *et al.*,2011).

For rapid and effective genetic improvement for any economic trait, early generation selection would be advantageous because a genotype possessing all the desirable genes either in homozygous or heterozygous condition occurs most often in the early segregating generations (F_2 and F_3).

Materials and Methods

Experimental material consisted of F_3 progenies belonging to four F_2 crosses selected based on yield superiority, *i.e*. 40 plants from Suraksha x Jalanidhi, 45 plants from Suraksha x Phalguna, 60 plants from Suraksha x Mahamaya and 55 plants from Suraksha x RP Bio-226 (Table 1). The seed of 40 to 60 single plants selected based on yield superiority in F_2 generation were obtained and raisedtheF_3 generation to study selection gain for yield. A total of 200 progenies were studied in F_3 generation during *kharif*, 2014. All the 200 entries belonging to four selected rice crosses were sown separately on 4th July, 2014 in a well prepared nursery bed. All the recommended crop management practices and plant protection measures were followed for raising a healthy nursery and main crop. The experimental material obtained from the Mrs. D. Sravani, Ph.D. research work completed under the Co-chairmanship of Dr. V. Ravindra Babu (Project Director).Crop Improvement section, Indian Institute of Rice Research (IIRR), Rajendranagar, Hyderabad.

Selection intensity

Proportion of number of selected plants or lines to the total number of plants or lines in the original population (Singh, 2012 and Chahal and Gosal, 2014).

$$\text{Selection intensity} = \frac{q}{n} \times 100$$

Whereas,

q = Number of selected plants or lines

n = Total number of plants or lines in the original population

Selection differential

A measure of the gain achieved by selection, the phenotypic superiority of selected individuals, compared to the population from which they were selected.

Selection differential (S) = $\overline{X}p - \overline{X}$

$\overline{X}$ = Overall mean of population
$\overline{X}p$ = Mean of selected plants

It depends upon the phenotypic standard deviation (σp) of the population and the proportion of plants selected for raising next generation (Falconer, 1989).

Genetic advance under selection (Selection gain)

Selection, of necessity, is based on of phenotype, which is produced by the joint action of genotype and the environment,

therefore, the phenotypic superiority of selected plants or families over the original population is not solely due to their genotypic superiority. In any case, progeny of selected plants, *i.e.* selected families are expected to be superior to the original or base population.

Improvement in the mean genotypic value of the selected families over that of the base population is known as genetic advance under selection (*Gs*) (Singh, 2012 and Chahal and Gosal, 2014).

The magnitude of *Gs* depends upon

The extent of phenotypic variability among different plants or families in the base population.

Heritability of the character under selection

Intensity of selection *i.e.* the proportion of plants or families selected.

Gs may be estimated as follows.

$Gs = (k)(\sigma p)(H)$

Where,

Gs= Genetic advance under selection,

K= Selection differential (Constant),

σp= Phenotypic standard deviation,
H= Heritability of character under selection.

Then,

Expected mean value = mean of parental population + genetic advance (*Gs*)

Results and Discussion

Selection intensity and selection gain were estimated for 200 rice progenies of four crosses in segregating generations for mean yields and the results obtained from the study are presented below.

Highest selection intensity was observed for the crosses Suraksha x RP Bio-226andSuraksha x Jalanidhi, whereas lowest selection intensity was observed for the cross Suraksha x Phalguna (15.50%). When comparing selection intensity in between F_2 and F_3, generations it was increased for all crosses studied in the experiment, indicating that the selections were progressed towards yield improvement. Results are furnished in (Tables 2 and3) and (Figs 1, 2, 3 and 4).

Selection differential in F_3 generation was 4.64g for Suraksha x Jalanidhi, 4.81g for Suraksha x Phalguna, 4.70g for Suraksha x Mahamaya and 5.37g for Suraksha x RP Bio-226. Selection differential results presented in the tables 4 and 5.

Values of selection differential (k), for different selection intensity levels

Selection intensity in percentage	Value of k
1	2.64
2	2.42
5	2.05
10	1.76
20	1.40
30	1.16

Table.1 Details of four crosses of rice (*Oryza sativa* L.)

S. No	Cross	Source
1	Suraksha x Jalanidhi	(F_2:F_3) IIRR, Rajendranagar.
2	Suraksha x Phalguna	(F_2:F_3) IIRR, Rajendranagar.
3	Suraksha x Mahamaya	(F_2:F_3) IIRR, Rajendranagar.
4	Suraksha x RP Bio-226	(F_2:F_3) IIRR, Rajendranagar.

Table.2 Selection intensity in F_3 segregating generation of Rice (*Oryza sativa* L.) based on mean yields

S. NO	Suraksha x Jalanidhi		Suraksha x Phalguna		Suraksha x Mahamaya		Suraksha x RPBio-226	
	F_3	Selected plants	F_3	Selected plants	F_3	Selected plants	F_3	Selected plants
1	31.93		26.28		34.65		27.93	
2	30.57		32.90		31.45		*38.63	1
3	29.75		28.17		29.35		*37.48	2
4	32.21		32.04		34.45		28.41	
5	26.85		22.90		*35.10	1	30.11	
6	31.10		32.43		34.80		31.78	
7	23.32		26.77		31.00		*38.73	3
8	23.56		*33.36	1	*36.60	2	34.89	
9	22.32		17.16		31.40		27.24	
10	*36.50	1	24.27		29.80		29.80	
11	31.26		*33.75	2	*35.25	3	33.72	
12	*35.24	2	19.44		26.00		25.77	
13	*33.74	3	27.15		*35.15	4	34.68	
14	32.95		24.97		29.45		33.70	
15	31.15		27.93		34.90		33.44	
16	28.87		20.10		25.20		*36.43	4
17	*33.10	4	*33.70	3	25.30		32.92	
18	*33.41	5	32.65		28.70		*36.81	5
19	29.28		30.75		31.55		25.96	
20	29.25		28.75		25.00		*38.32	6
21	32.13		29.30		34.10		*37.99	7
22	28.20		*34.20	4	*35.90	5	34.58	
23	*35.24	6	32.00		34.05		27.95	
24	*34.65	7	*34.20	5	*35.25	6	31.81	
25	25.32		32.20		*35.34	7	*36.05	8
26	28.67		*35.60	6	27.94		25.17	
27	30.82		27.60		27.08		27.13	
28	31.07		28.95		31.29		*38.92	9
29	19.46		27.00		31.61		26.14	
30	30.12		26.30		33.34		30.82	
31	*33.83	8	31.85		23.93		27.09	
32	24.16		30.75		31.81		31.47	
33	32.72		26.15		33.48		31.74	
34	31.55		27.75		29.35		33.01	
35	24.89		29.00		*36.50	8	32.46	
36	29.00		32.65		30.80		34.79	
37	24.65		31.25		30.35		*36.10	10
38	31.96		*35.25	7	24.82		31.24	
39	28.93		31.35		28.15		*36.20	11
40	29.38		30.50		*36.09	9	34.99	
41			31.90		25.23		32.80	
42			32.75		33.97		28.52	
43			29.15		27.11		29.78	
44			31.20		27.10		28.23	

45			32.70		*35.42	10	34.87	
46					26.80		29.96	
47					33.71		30.20	
48					21.52		33.39	
49					22.81		27.64	
50					34.99		26.65	
51					23.13		28.66	
52					33.90		33.20	
53					17.16		32.92	
54					33.94		29.15	
55					29.54		34.82	
56					34.80			
57					34.69			
58					29.59			
59					33.92			
60					34.98			
Total no of plants and selected plants in F_3	40	8	45	7	60	10	55	11
Selection intensity (%)	20%		15.5%		16.66%		20%	
*** Progenies selected in F_3.**								

Table.3 Comparison of selection intensity between F_2 and F_3 generations

Suraksha x Jalanidhi				**Suraksha x Phalguna**				**Suraksha x Mahamaya**				**Surakasha x RP Bio-226**			
F_2		F_3		F_2		F_3		F_2		F_3		F_2		F_3	
BP	SP	BP	SP	BP	SP	BP	SP	BP	SP	BP	SP	BP	SP	BP	SP
800	40	40	8	900	45	45	7	600	60	60	10	600	65	65	12
5%		**20%**		**5%**		**15.5%**		**10%**		**16.66%**		**9.16%**		**20%**	
BP-Base population, **SP**-Selected population.															

Table.4 Selection differential in F_2 segregating generation of rice (*Oryza sativa* L.) for mean yields

Cross	**Overall mean yield of population in F_2 (X)**		**Top selected plants mean yield in F_2 (X*p*)**		**Selection differential (X – X*p*)**
	No. of plants	**Mean (g)**	**No. of plants**	**Mean (g)**	
Suraksha x Jalanidhi	800	25.86	40	33.25	7.39
Suraksha x Phalguna	900	22.40	45	25.86	3.46
Suraksha x Mahamaya	600	23.15	60	27.65	4.50
Suraksha x RP Bio-226	600	29.50	55	35.50	6.00

Table.5 Selection differential in F_3 segregating generation of rice (*Oryza sativa* L.) for mean yields

Cross	**Overall mean yield of population in F_3 (X)**		**Top selected progenies mean yield in F_3 (X*p*)**		**Selection differential (X*p* -X)**
	No. of plants	**Mean (g)**	**No. of plants**	**Mean (g)**	
Suraksha x Jalanidhi	40	29.82	8	34.46	4.64
Suraksha x Phalguna	45	29.48	7	34.29	4.81
Suraksha x Mahamaya	60	30.84	10	35.54	4.70
Suraksha x RP Bio-226	55	32.05	12	37.42	5.37

Table.6 Genetic advance in F_2 generation of rice *(Oryza sativa* L.*)* for mean yields

CROSS	Heritability (H)	Standard deviation (σ*p*)	Selection differential (k) (Constant)	Genetic Advance (*Gs*)
Suraksha x Jalanidhi	0.89	3.92	1.40	4.88
Suraksha x Phalguna	0.95	4.27	1.76	7.13
Suraksha x Mahamaya	0.91	4.44	1.76	7.11
Suraksha x RP Bio-226	0.94	3.90	1.40	5.13

Table.7 Genetic advance in F_3 generation of rice *(Oryza sativa* L.*)* for mean yields

Cross	Heritability (H)	Standard deviation (σ*p*)	Selection differential (k) (Constant)	Genetic Advance (*Gs*)
Keshari x IR-64	0.89	3.92	1.40	4.88
Keshari x RPBio226	0.95	4.27	1.76	7.13
Keshari x Swarna	0.91	4.44	1.76	7.11
Keshari x NDR359	0.94	3.90	1.40	5.13

Table.8 Selection gain obtained from F_2 generation to F_3 generation of rice *(Oryza sativa* L.*)* for mean yields

CROSS	Overall mean seed yield of total population in F_2 generation (g)	Genetic Advance (*Gs*)	Expected mean yield of top selected progenies in F_3 generation (g)	Evaluation of top selected progenies from F_2 for mean yield in F_3 generation (g)	Selection gain	Result
Suraksha x Jalanidhi	25.86	6.31	31.17	29.82	-1.32	Decreased
Suraksha x Phalguna	22.40	5.59	27.99	29.48	+1.61	Increased
Suraksha x Mahamaya	23.15	6.23	29.38	30.84	+1.46	Increased
Suraksha x RP Bio-226	29.50	4.44	33.94	32.05	-1.89	Decreased

Table.9 Expected mean yield of top progenies selected from F_3 generation of rice in F_4 generation

CROSS	Overall mean seed yield of total population in F_3 generation (g)	Genetic Advance (*Gs*)	Population of progenies grown from the top selected lines is expected to have mean value (g)
Suraksha x Jalanidhi	29.82	4.88	34.70
Suraksha x Phalguna	29.48	7.13	36.61
Suraksha x Mahamaya	30.84	7.11	37.95
Suraksha x RP Bio-226	32.05	5.13	37.18

Fig.1 Histogram representing the mean yields in F_2 and F_3 segregating generations of the Suraksha X Jalanidhi cross of rice (*Oryza sativa* L.)

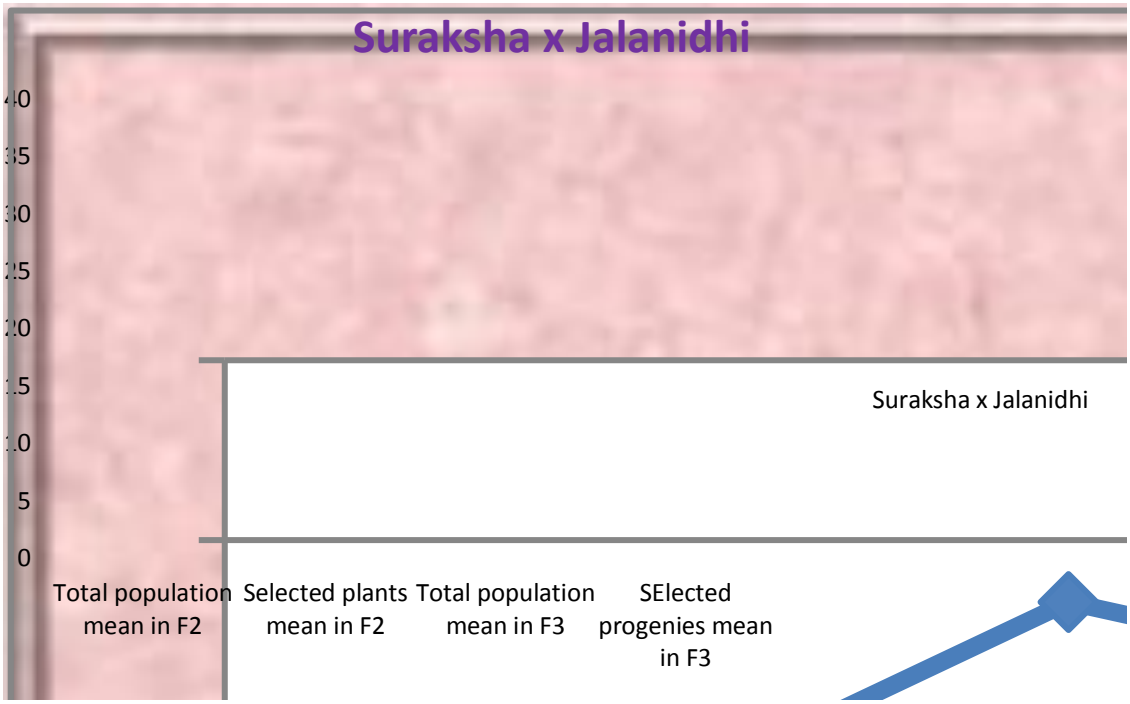


Fig.2 Histogram representing the mean yields in F_2 and F_3 segregating generations of the Suraksha X Phalguna cross of rice (*Oryza sativa* L.)

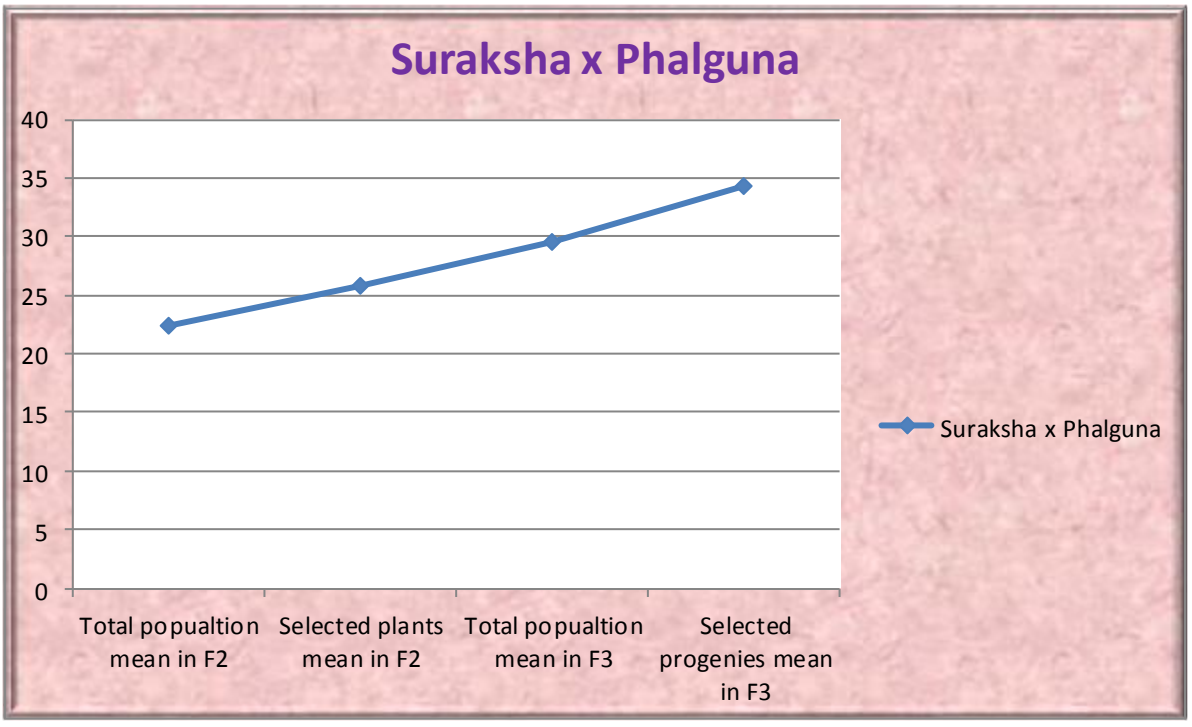


Fig.3 Histogram representing the mean yields in F_2 and F_3 segregating generations of the Suraksha X Mahamaya cross of rice (*Oryza sativa* L.)

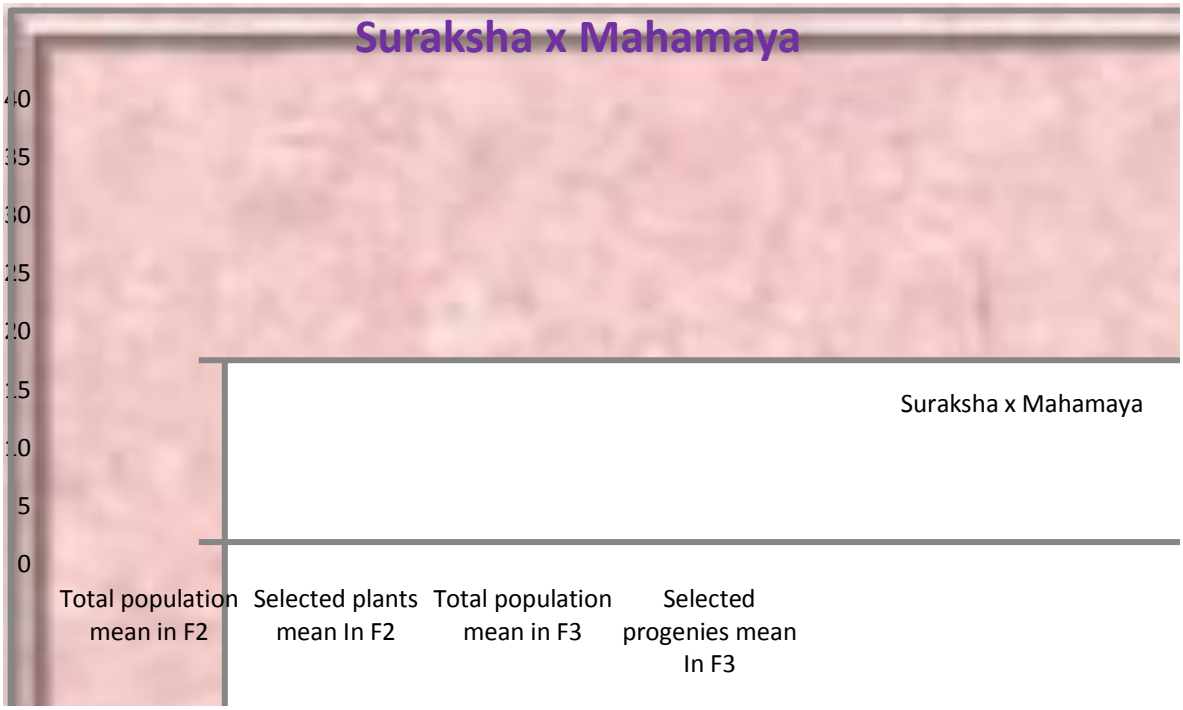
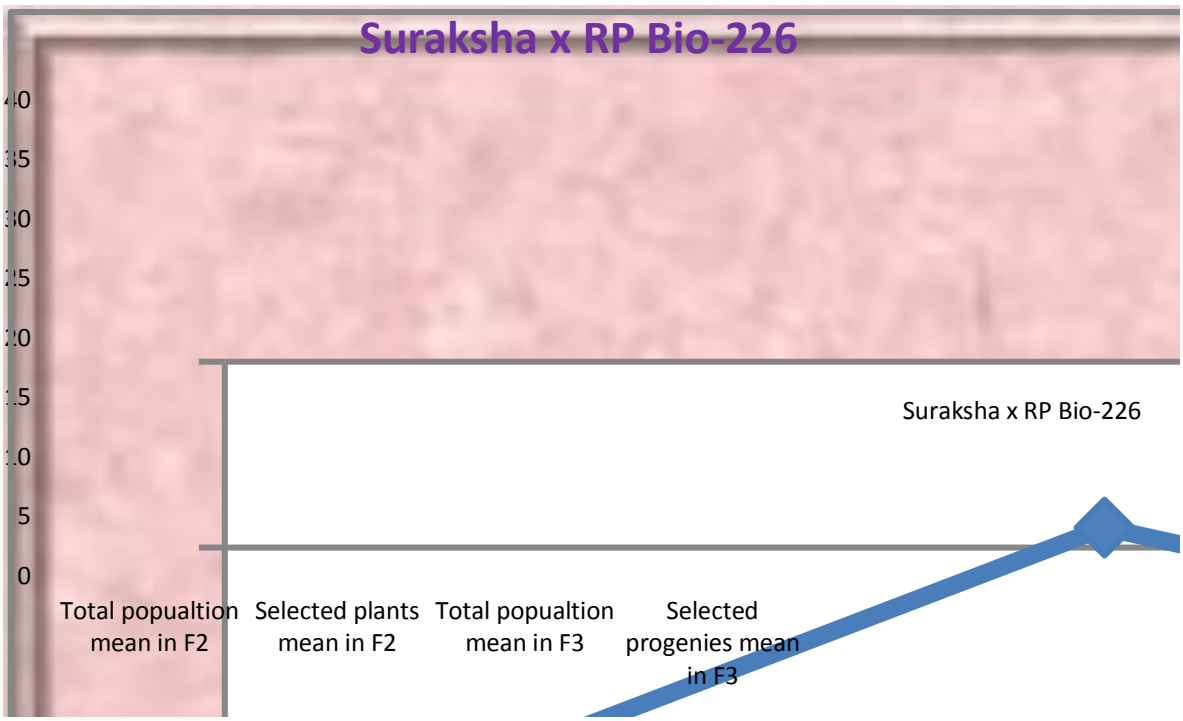


Fig.4 Histogram representing the mean yields in F_2 and F_3 segregating generations of the Suraksha X RP Bio-226 cross of rice (*Oryza sativa* L.)



Selection gain is greater than the expected mean yield in F_3 generation for the cross Suraksha x Phalguna (+1.61) and Suraksha x Mahamaya (+1.46), i.e., increased for both crosses in next generation, indicating that selection is effective for that particular character. Selection gain is lower than expected mean yield for the cross Suraksha x Jalanidhi (-1.32) and Suraksha x RP Bio-226, i.e., decreased for both crosses in next generation, indicating that selection is ineffective for grain yield. These results are furnished in the (Table 6, 7, 8 and 9). Similar results are in accordance with Mukul Kumar *et al.*, 2009 and Haul Sttrek and Necmi Beser. 2003.

The effectiveness of early generation selection was observed through significant and positive correlations between F_2 and F_3 (Pawar *et al.,* 1989) and between F_2 and $F_3$and F_3 and F_4 (Saini and Gautam, 1990) in wheat. The numerous reports on intergeneration association are available in other crops, but adequate information is not available on this aspect in rice.

References

Amrit Patel. 2008. Budget 2008-09 to accelerate process of farm and rural development. Kurukshetra, 56:11-15.

Anonymous, 2007. Agriculture and Industry Survey. 17 (11): 18-20.

Child, N.W.2004. Production and utilization of rice. P. 1- 23. In: E.T. Champagne (Ed). Rice chemistry and technology. 3rd, Ann. Association of cereal chemistry, St, Paul. MN.

Singh, B.D. 2014. *Plant Breeding Principles and Methods.* Ninth Revised Edition, Kalyani Publishers. pp. 167-169.

Chahal, G.S. and Gosal, S.S. 2014. Principles and procedures of plant breeding. Seventh Reprint, Narosha. 158-161.

Anilkumar, C. Vanniarajan1 and J. Ramalingam2. 2011. Parent Progeny regression analysis in F2 and F3 generations of rice. Electronic Journal of Plant Breeding, 2(4):520-522.

Pawar IS, Srivastava RB and Yunus M 1989. A study of intergeneration correlation in four wheat crosses. Haryana Agric Univ J Res 19:76-78.

Saini DP and Gautam PL 1990. Early generation selection indurum wheat. Indian J Genet 50: 147-152.

Mukul Kumar, Nitendra Prakash and Ph. Ranjit Sharma. 2009. Effectiveness of F_2 and F_3 plant selection for yield and its components in rice. Oryza Vol. 46. No.1, 17-20.

Haul Sttrek and Necmi Beser. 2003. Selection for Grain Yield and Yield Components in Early

Generations for Temperate Rice. Philippine Journal of Crop Science 2003, 28(3) 3-15.

Falconer, D.S. 1981. *Introduction to quantitative genetics.* Oliver Boyd, London pp. 340.

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