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Strategy of F1 Hybrid Rice Seed Production through CMS Breeding Technology

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Abstract:

It is a major problem of emerging the inflorescence from the first leaf of this crop which is managed by spraying GA3 plant hormone in different concentrations. GA3 is a costly chemical which is a matter of problem to afford by the middle class farmers as well as margin farmers. It would be helpful to the rice breeders as well as scientific community if we could explore the alternative low cost chemicals instead of GA3 to fulfill the purpose of this breeding technology. Different doses of chemical viz. GA3, penicillin, Sulfonamide, and gentamicin were applied as foliar spay during flowering times in three phases. This practice for producing F1 seeds from the A-line and R-line were done in both the seasons i.e. (i) winter-summer-boro and (ii) kharif seasons. The produced F1 seeds as well as R-line seeds were measured in various agronomic parameters for assessing the seasonal variations over the same location. Fourteen metrical were observed and recorded properly for biometrical calculations. Correlation matrix model (1) was followed for determining the metrical traits of cultivars studied. The main aims and objectives of this experiment were to assess the effectiveness of different chemicals for emerging out the inflorescence of 'A' line parent cultivar of the experiment.

Key word: Alternative chemicals, CMS breeding, Explore

1- Introduction

High yielding rice cultivars were evolved during 1960's in our country to fulfil green revolution moto. Initially, the photosensitive indica rice cultivars were replaced by Taichung Native 1 and thereafter IR8. But indeed, it was a great problem of water stress for the cultivation of IR8 (160 days) in winter-summer-boro season where we had low sufficient artificial irrigation facilities in our country. In course of time, within a couple of years a few promising rice cultivars (110-115 days) were evolved to replace IR8 rice cultivar. Thereafter the enhanced production of rice become deteriorated due to genetic erosion, technological shortfalls and agronomical practices. The basic work on hybrid rice was initiated in early seventies (4). More organised and systematic research on both basic and applied aspect was started by Indian Council of Agricultural Research (ICAR) in December, 1989 under a mission mode project. The cytoplasmic male sterile (CMS) lines of Chinese origin were received through International Rice Research Institute, Philippines. Earlier work has been conducted by Tah, 2008(2); Pal and Tah, 2011 (3), in this laboratory.

After independence we had to face severe famine in the country in 1940s'. The quantity of food production which we had achieved from green revolution of the sixties could have met up the present food scarcity of increasing by growing population of our country. Cereal crop yield could reach 3-6 times more yield by introducing new high yielding photo insensitive cultivars (especially in case of rice). Gradually the green revolution has converted as 'green' to 'greed' by sacrificing some traditional valuable indica rice cultivars. Seed to seed duration of indica rice cultivars has reduced in 115-120 days from its long duration i.e. 160-170 days. 'Taichung' Native-1 rice variety was introduced in India first in 1965 but it could not survive in this country in any agroclimatic zone out of 6 zones in our country. Simultaneously the scientists of International Rice Research Institute discovered the most high yielding rice cultivar IR-8 for maximum yield in tropical country like India. The seed to seed duration of IR-8 was 130-135 days. It was a matter of water stress for the cultivation of IR-8 in winter- summer- boro season in artificial irrigation. Indeed, we had no sufficient arrangement of artificial irrigation for boro cultivation of rice cultivars at that time. In course of time a few rice cultivars were evolved which were 110-115 days of seed duration and replace the IR-8 rice cultivars. The cultivation of high yielding rice varieties became saturated in 1984-1985 in our country. Thereafter, the enhanced production of rice became deteriorated due to genetic erosion, technological shortfalls and agronomical practices. Within this seed production system, the out-crossing potential of the seed parent is assessed and the easy of production of particular hybrid combinations determined. The quality of output of the various seed production steps are determined through grow outs conducted after each season (5).

2- Materials and Methods

CMS abortive lines IR58025A and restorer line KMR-3 were collected from the State Rice Research Station, Chinsurah, Hoogly, in the month of Dec. 2011. These seeds were sown in the seedbed during Dec. 18-25, 2011 following the norms of CMS technology. After a month the seedlings were transplanted in the field following the CMS technology. In our case 6 (six) A-lines were transplanted having two R-lines aside both sides of each replication of A-line. Various metrical characters viz. 1. Plant height (cm), 2. Tiller/plant, 3. Leaves/plant, 5. panicle length (cm) /treatment, 6. Number of rachilla / panicle, 7. Number of grain/panicle, 8. Grain yield (g.) /plant, 10. Total yield/ hectare, 11. 1000 Grain wt. /treatment, 12. Length of grain (mm.) /treatment, 13. Breadth of grain (mm) /treatment, 14. Length of awn (mm.) /treatment 15. Straw wt. (kg.)/treatment were studied and all these data were recorded properly for further Analysis of co-variance calculations by the model as followed by Singh and Chaudhary (1).

Table A: Chemicals treatment for emerging out of A- line panicle:

Treatment	Chemical
T1	Control
T2	Penicillin
T3	Sulphonamide
T4	Gentamicin
T5	GA3

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3- Results

Fourteen metrical characters were analysed for calculating simple correlation matrix which are cited in Table 4 to 6. The two way table for all these fourteen metrical characters have not been cited in this context. But the combined ANCOVA table has been exhibited (Table – 1) for expressing individual 'F' – value of character studied. The components of co-variances values have been shown in the Table – 2

Table 1: Combined ANCOVA of all metrical traits of Oryza sativa L.

Character	Source of variation	df	S.P	M.P	F
1.2	Treatment	4	-0.95	-0.23	-0.71 ns
	Replication	4	-4.95	-1.23	-3.84 ns
	Error	16	5.25	0.32	
1.3	Treatment	4	-0.79	-0.19	-0.22 ns
	Replication	4	-51.99	-12.99	-15.28**
	Error	16	13.74	0.85	
1.4	Treatment	4	-2.6	-0.65	-1.54
	Replication	4	-33.5	-8.37	-19.92**
	Error	16	6.75	0.42	
1.5	Treatment	4	1.44	0.36	0.87 ns
	Replication	4	-1.46	-0.37	-0.89 ns
	Error	16	6.66	0.41	
1.6	Treatment	4	-14.1	-3.52	-2.46
	Replication	4	-255.7	-63.92	-44.69**
	Error	16	23	1.43	
1.7	Treatment	4	-4.36	-1.09	0.45 ns
	Replication	4	20.74	5.89	-2.14 ns
	Error	16	-38.84	-2.42	
1.8	Treatment	4	-0.63	-0.16	0.21
	Replication	4	-7.34	-1.83	2.54
	Error	16	-11.60	-0.72	
1.9	Treatment	4	-0.85	-0.21	10.5**
	Replication	4	-1.27	-0.31	15.5**
	Error	16	-0.37	-0.02	
1.10	Treatment	4	-0.46	-0.11	0.14 ns
	Replication	4	-1.89	-0.47	0.61 ns
	Error	16	-12.26	-0.76	
1.11	Treatment	4	0.81	0.20	-0.58
	Replication	4	-22.99	-5.74	16.88**
	Error	16	-5.46	-0.34	
1.12	Treatment	4	0.19	0.04	0.16 ns
	Replication	4	0.99	0.24	0.96 ns
	Error	16	4.01	0.25	
1.13	Treatment	4	-0.66	-0.16	0.94 ns
	Replication	4	-3.87	-0.96	5.64
	Error	16	-2.78	-0.17	
1.14	Treatment	4	1.07	0.27	0.64 ns
	Replication	4	1.29	0.32	0.76 ns
	Error	16	6.76	0.42	
2.3	Treatment	4	7.1	1.77	0.59 ns
	Replication	4	19.15	4.79	1.61 ns
	Error	16	47.6	2.97	
2.4	Treatment	4	3.60	0.90	4.09 ns
	Replication	4	-1.44	-0.36	-1.63 ns
	Error	16	3.59	0.22	
2.5	Treatment	4	-0.6	-0.15	0.29 ns
	Replication	4	1.1	0.27	0.53 ns
	Error	16	-8.1	-0.51	
2.6	Treatment	4	5	1.25	2.60 ns
	Replication	4	-5.8	-1.45	-3.02 ns
	Error	16	-7.7	0.48	
2.7	Treatment	4	-3.5	-0.87	0.01 ns
	Replication	4	-15.3	-3.82	0.08 ns
	Error	16	-710.3	-44.39	
2.8	Treatment	4	-1.87	-0.46	-6.68**
	Replication	4	-0.97	-0.24	-3.42**
	Error	16	1.21	0.07	
2.9	Treatment	4	1.41	0.35	1.96 ns
	Replication	4	2.59	0.65	3.61
	Error	16	2.97	0.18	
2.10	Treatment	4	-2.16	-0.54	10.8**

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Character	Source of variation	df	S.P	M.P	F
	Replication	4	1.48	0.37	-7.4**
	Error	16	-0.8	-0.05	
2.11	Treatment	4	-0.9	-0.22	3.75
	Replication	4	5.55	1.39	-23.16**
	Error	16	-1.05	-0.06	
2.12	Treatment	4	-0.4	-0.10	-1.11 ns
	Replication	4	-1.6	-0.40	4.44
	Error	16	1.4	0.09	
2.13	Treatment	4	0.25	0.06	1.25 ns
	Replication	4	0.08	0.02	0.40 ns
	Error	16	0.89	0.05	
2.14	Treatment	4	0.46	0.11	0.50 ns
	Replication	4	1.17	0.29	1.33 ns
	Error	16	3.51	0.22	
3.4	Treatment	4	9	2.25	1.87 ns
	Replication	4	12.5	3.12	2.6 ns
	Error	16	19.15	1.20	
3.5	Treatment	4	-1.46	-0.37	0.32 ns
	Replication	4	1.74	0.44	0.38 ns
	Error	16	-18.04	-1.13	
3.6	Treatment	4	3.5	0.88	-0.17 ns
	Replication	4	18.2	4.55	-0.89 ns
	Error	16	-20.5	-5.12	
3.7	Treatment	4	-11.26	-2.81	0.02 ns
	Replication	4	-45.56	-11.39	0.08 ns
	Error	16	-2257.04	-141.06	
3.8	Treatment	4	-8.24	-2.06	29.42**
	Replication	4	-0.10	-0.02	0.28 ns
	Error	16	-1.15	-0.07	
3.9	Treatment	4	2	0.5	0.75 ns
	Replication	4	9.69	2.42	3.67 ns
	Error	16	10.54	0.66	
3.10	Treatment	4	-6.33	1.58	1.50 ns
	Replication	4	3.51	0.87	0.82 ns
	Error	16	-16.86	1.05	
3.11	Treatment	4	1.11	0.28	0.85 ns
	Replication	4	23.76	5.94	-18**
	Error	16	-5.36	-0.33	
3.12	Treatment	4	-0.16	0.04	0.66 ns
	Replication	4	-1.16	0.29	4.83
	Error	16	0.97	0.06	
3.13	Treatment	4	0.09	0.02	0.20 ns
	Replication	4	0.16	0.04	0.36 ns
	Error	16	-1.87	0.11	
3.14	Treatment	4	-2179.4	544.85	2.00 ns
	Replication	4	-2179.3	544.82	2.00 ns
	Error	16	4341.4	271.33	
4.5	Treatment	4	-6.50	-1.62	4.90**
	Replication	4	-0.10	-0.02	0.06 ns
	Error	16	-5.3	-0.33	
4.6	Treatment	4	24.5	6.12	29.14**
	Replication	4	38.8	9.7	46.19**
	Error	16	-3.3	-0.21	
4.7	Treatment	4	2.2	0.55	0.003 ns
	Replication	4	-7.6	1.9	0.01ns
	Error	16	287.7	179.81	
4.8	Treatment	4	0.97	0.24	0.73ns
	Replication	4	1.59	0.39	1.18 ns
	Error	16	-5.38	-0.33	
4.9	Treatment	4	-0.27	0.67	33.5**
	Replication	4	1.22	0.31	15.5**
	Error	16	0.29	0.02	
4.10	Treatment	4	-0.71	0.17	0.63 ns
	Replication	4	0.11	0.02	0.07 ns
	Error	16	-4.38	0.27	
4.11	Treatment	4	2.25	0.56	2.24 ns
	Replication	4	7.65	1.91	7.64**
	Error	16	-4	-0.25	
4.12	Treatment	4	0.9	0.22	1.57 ns
	Replication	4	1.5	0.37	2.64 ns
	Error	16	-2.26	0.14	
4.13	Treatment	4	1.46	0.36	3.6 ns
	Replication	4	0.81	0.20	2 ns
	Error	16	1.61	0.10	
4.14	Treatment	4	-1.56	-0.39	-0.97 ns
	Replication	4	-0.51	-0.13	0.32 ns
	Error	16	6.48	0.40	
5.6	Treatment	4	-14.2	-3.55	355**
	Replication	4	3.2	0.8	80**
	Error	16	-0.2	-0.01	
5.7	Treatment	4	-3.64	-0.19	0.01 ns
	Replication	4	-1.24	-0.31	0.004 ns
	Error	16	-1213.36	-75.84	
5.8	Treatment	4	-3.03	0.75	4.68**
	Replication	4	-0.03	0.007	0.04 ns
	Error	16	-2.57	0.16	
5.9	Treatment	4	0.93	0.23	2.87 ns
	Replication	4	0.07	0.01	0.12 ns
	Error	16	1.25	0.08	
5.10	Treatment	4	-1.29	0.32	0.64 ns
	Replication	4	0.15	0.03	0.06 ns
	Error	16	8.05	0.50	

Character	Source of variation	df	S.P	M.P	F
5.11	Treatment	4	-1.56	0.39	0.20 ns
	Replication	4	0.44	0.11	0.73 ns
	Error	16	-8.54	0.53	
5.12	Treatment	4	-0.74	0.18	3.6 ns
	Replication	4	-0.24	-0.06	1.2 ns
	Error	16	0.84	0.05	
5.13	Treatment	4	-0.93	0.23	0.72 ns
	Replication	4	-0.05	0.01	0.03 ns
	Error	16	-5.27	0.32	
5.14	Treatment	4	1.42	0.35	8.75**
	Replication	4	0.14	0.03	0.75 ns
	Error	16	0.7	0.04	
6.7	Treatment	4	-4427702.6	-1106925.65	4.01 ns
	Replication	4	-4427722.2	-1106930.55	4.01ns
	Error	16	4411182	275698.92	
6.8	Treatment	4	-10.14	2.61	1.41 ns
	Replication	4	19.38	4.85	2.62 ns
	Error	16	-29.6	1.85	
6.9	Treatment	4	9.01	2.25	9**
	Replication	4	-18.64	-4.66	18.64**
	Error	16	-3.94	-0.25	
6.10	Treatment	4	4.86	1.22	0.0005 ns
	Replication	4	0.6	0.15	0.00007ns
	Error	16	-33731.52	2108.22	
6.11	Treatment	4	-1.6	-0.4	2.22 ns
	Replication	4	1.7	0.42	2.33ns
	Error	16	-2.9	-0.18	
6.12	Treatment	4	-0.9	-0.22	0.69ns
	Replication	4	-11	-2.75	8.59**
	Error	16	5.2	0.32	
6.13	Treatment	4	6.88	1.72	1.25 ns
	Replication	4	9.9	2.48	1.81 ns
	Error	16	21.86	1.37	
6.14	Treatment	4	-13.6	3.4	11.40**
	Replication	4	-4.54	1.13	3.79 ns
	Error	16	-4.78	0.30	
7.8	Treatment	4	-2.65	-0.66	0.006 ns
	Replication	4	1.77	0.44	-0.004 ns
	Error	16	-1551.77	-96.98	
7.9	Treatment	4	2.31	0.58	-0.02 ns
	Replication	4	-8.14	-2.03	0.08 ns
	Error	16	-412.43	-25.78	
7.10	Treatment	4	5.4	1.35	-0.01 ns
	Replication	4	-2.52	-0.63	0.006ns
	Error	16	-1561.28	-97.58	
7.11	Treatment	4	-0.16	0.04	0.0005 ns
	Replication	4	-18.56	4.64	0.06 ns
	Error	16	-1198.54	74.90	
7.12	Treatment	4	-0.14	0.03	0.001 ns
	Replication	4	-0.44	0.11	0.006 ns
	Error	16	-278.46	17.40	
7.13	Treatment	4	2.37	0.59	0.01 ns
	Replication	4	2.54	0.64	0.01 ns
	Error	16	-559.71	34.98	
7.14	Treatment	4	-6.46	1.61	0.02ns
	Replication	4	-1.7	0.42	0.007ns
	Error	16	-916.12	57.25	
8.9	Treatment	4	-2.93	0.73	-5.62**
	Replication	4	-0.48	-0.12	0.92 ns
	Error	16	-2.04	-0.13	
8.10	Treatment	4	4.88	1.22	11.09**
	Replication	4	-0.07	0.01	0.18 ns
	Error	16	1.7	0.11	
8.11	Treatment	4	-2.19	0.55	6.11**
	Replication	4	0.07	0.02	0.22 ns
	Error	16	1.36	0.09	
8.12	Treatment	4	0.47	0.12	0.92 ns
	Replication	4	-0.08	0.02	0.15ns
	Error	16	-2.06	0.13	
8.13	Treatment	4	0.53	0.13	0.72 ns
	Replication	4	0.21	0.05	-0.27 ns
	Error	16	-2.9	-0.18	
8.14	Treatment	4	-0.57	0.14	0.82 ns
	Replication	4	-0.24	0.06	0.35 ns
	Error	16	-2.69	0.17	
9.10	Treatment	4	-0.93	-0.23	0.002 ns
	Replication	4	1982.55	495.64	4.00
	Error	16	-1982.84	123.93	
9.11	Treatment	4	-1.58	0.40	3.64
	Replication	4	3.80	0.95	8.64
	Error	16	-1.82	0.11	
9.12	Treatment	4	0.72	0.18	2.57 ns
	Replication	4	0.24	0.06	0.85 ns
	Error	16	1.18	0.07	
9.13	Treatment	4	0.19	0.05	1 ns
	Replication	4	-0.39	0.10	1.94 ns
	Error	16	0.74	0.05	
9.14	Treatment	4	-0.22	-0.05	0.42 ns
	Replication	4	0.22	0.06	0.50 ns
	Error	16	1.88	0.12	
10.11	Treatment	4	-1982.38	495.60	2.00 ns
	Replication	4	-1980.96	495.24	2.00 ns

Character	Source of variation	df	S.P	M.P	F
	Error	16	-3960.25	247.52	
10.12	Treatment	4	0.24	0.07	7**
	Replication	4	-0.23	0.06	-6**
	Error	16	0.27	-0.01	
10.13	Treatment	4	0.39	0.097	0.21 ns
	Replication	4	-0.01	-0.002	0.004 ns
	Error	16	7.19	0.47	
10.14	Treatment	4	-1.25	0.31	1.24 ns
	Replication	4	0.13	0.03	0.12 ns
	Error	16	-4	-0.25	
11.12	Treatment	4	0.99	0.25	2.08 ns
	Replication	4	0.59	0.15	1.25 ns
	Error	16	-1.94	0.12	
11.13	Treatment	4	-0.11	0.03	0.16 ns
	Replication	4	0.18	0.05	0.26 ns
	Error	16	3.03	0.19	
11.14	Treatment	4	-0.06	0.01	0.02 ns
	Replication	4	0.39	0.097	0.22 ns
	Error	16	-6.99	0.44	
12.13	Treatment	4	0.01	0.21	3.5 ns
	Replication	4	-0.05	0.01	0.16 ns
	Error	16	0.89	0.06	
12.14	Treatment	4	-0.08	0.02	0.4 ns
	Replication	4	-0.11	0.03	0.6 ns
	Error	16	0.87	0.05	
13.14	Treatment	4	-0.59	-0.15	-0.94 ns
	Replication	4	0.03	0.008	0.05 ns
	Error	16	-2.50	0.16	

Table 2: Components of co-variances of fourteen metrical traits studied of Oryza sativa L.

combination	δgigj	δeiej	δpipj
1.2	-0.11	0.32	0.21
1.3	-0.21	0.85	0.64
1.4	-0.21	0.42	0.21
1.5	-0.01	0.41	0.40
1.6	-0.99	1.43	0.44
1.7	0.26	-2.42	-2.15
1.8	0.11	-0.72	-0.61
1.9	0.03	-0.02	0.01
1.10	0.13	-0.76	-0.63
1.11	0.10	-0.34	-0.24
1.12	-0.04	0.25	0.21
1.13	0.002	-0.17	-0.17
1.14	-0.03	0.42	0.39
2.3	-0.24	2.97	2.73
2.4	0.14	0.22	0.36
2.5	0.07	-0.51	-0.44
2.6	0.15	0.48	0.63
2.7	8.70	-44.39	-35.69
2.8	-0.11	0.07	-0.04
2.9	0.03	0.18	0.21
2.10	0.09	-0.05	0.04
2.11	-0.03.	-0.06	-0.09
2.12	-0.04	0.09	0.05
2.13	0.002	0.05	0.05
2.14	-0.02	0.22	0.20
3.4	0.21	1.20	1.41
3.5	0.15	-1.13	-0.98
3.6	1.19	-5.12	-3.93
3.7	27.65	-141.06	-113.41
3.8	-0.39	-0.07	-0.46
3.9	-0.03	0.66	0.63
3.10	0.10	1.05	1.15
3.11	0.12	-0.33	-0.21
3.12	-0.004	0.06	0.06
3.13	-0.01	0.11	0.10
3.14	54.70	271.33	326.03
4.5	-0.26	-0.33	-0.59
4.6	1.26	-0.21	1.05
4.7	-35.85	179.81	143.96
4.8	0.11	-0.33	-0.22
4.9	0.13	0.02	0.15
4.10	-0.02	0.27	0.25
4.11	0.16	-0.25	-0.09
4.12	0.02	0.14	0.16
4.13	0.05	0.10	0.15
4.14	-0.16	0.40	0.24
5.6	-0.71	-0.01	-0.72
5.7	14.99	-75.84	-60.85
5.8	0.12	0.16	0.28
5.9	0.03	0.08	0.11
5.10	-0.04	0.50	0.46
5.11	-0.03	0.53	0.50
5.12	0.02	0.05	0.07
5.13	-0.02	0.32	0.30
5.14	0.06	0.70	0.76
6.7	-276524.91	275698.92	-825.99
6.8	0.15	1.85	2.00
6.9	0.50	-0.25	0.25
6.10	-421.40	2108.22	1686.82
6.11	-0.04	-0.18	-0.22
6.12	0.11	0.32	0.21
6.13	0.07	1.37	1.44
6.14	0.62	0.30	0.91
7.8	19.26	-96.98	-77.72
7.9	5.04	-25.78	-20.70
7.10	19.79	-97.58	-77.79
7.11	14.98	74.90	89.80
7.12	-3.47	17.40	13.93
7.13	6.88	34.98	41.86
7.14	-11.13	57.25	46.12
8.9	0.17	-0.13	0.04
8.10	0.22	0.11	0.33
8.11	0.09	0.09	0.18
8.12	-0.002	0.13	0.13
8.13	0.06	-0.18	-0.12
8.14	-0.006	0.17	0.16
9.10	-24.83	123.93	99.1
9.11	0.06	0.11	0.17
9.12	0.02	0.07	0.09
9.13	0.00	0.05	0.05
9.14	0.03	0.12	0.15
10.11	49.62	247.52	297.14
10.12	-1.40	-0.01	1.41
10.13	0.04	0.47	0.51
10.14	0.25	-0.25	0.00
11.12	0.03	0.12	0.15
11.13	-0.04	0.19	0.15
11.14	-0.09	0.44	0.35
12.13	0.03	0.06	0.09
12.14	-0.006	0.05	0.04
13.14	-0.06	0.06	0.10

Table 3: Co-heritability of all metrical traits studied of Oryza sativa L

Combination	Coheritability	Combination	Coheritability	Combination	Coheritability
1.2	-0.52	3.10	0.09	6.14	0.68
1.3	-0.32	3.11	-0.57	7.8	0.25
1.4	-1.00	3.12	-0.07	7.9	0.24
1.5	-0.02	3.13	-0.10	7.10	0.25
1.6	-2.26	3.14	0.17	7.11	0.17
1.7	-0.12	4.5	0.44	7.12	0.25
1.8	-0.18	4.6	1.20	7.13	0.16
1.9	3.00	4.7	-0.25	7.14	0.24
1.10	-0.20	4.8	-0.50	8.9	4.25
1.11	-0.42	4.9	0.87	8.10	0.66
1.12	-0.19	4.10	-0.08	8.11	0.50
1.13	-0.01	4.11	-1.77	8.12	-0.02
1.14	-0.08	4.12	0.12	8.13	0.50
2.3	-0.09	4.13	0.33	8.14	-0.04
2.4	0.39	4.14	-0.66	9.10	-0.25
2.5	-0.16	5.6	0.99	9.11	0.35
2.6	-0.24	5.7	-0.25	9.12	0.22
2.7	0.24	5.8	0.43	9.13	0.00
2.8	2.75	5.9	0.27	9.14	0.20
2.9	0.14	5.10	-0.09	10.11	0.16
2.10	2.25	5.11	-0.06	10.12	0.99
2.11	0.33	5.12	0.29	10.13	0.07
2.12	0.80	5.13	-0.07	10.14	0.00
2.13	0.08	5.14	0.08	11.12	0.20
2.14	-0.10	6.7	334.77	11.13	-0.27
3.4	0.15	6.8	0.08	11.14	-0.26
3.5	-0.15	6.9	2.00	12.13	0.33
3.6	-0.03	6.10	-0.25	12.14	-0.15
3.7	-0.24	6.11	0.18	13.14	-0.60
3.8	0.85	6.12	-0.52	-	-
3.9	-0.05	6.13	0.05	-	-

Discussion:

Almost all the cases the matrix value are within the limit i.e. 1.00. in a few cases, the matrix values have been exceeded. Normally, the matrix should be up to the limit at max 10.00. However, this value if exceed might be due to any other environmental factors or any genetic makeup of the genotype which are not adapted in this location. In our case, different treatments were undertaken for the study. Maximum variation might be happened for this treatment effect.

Photographs during cropping time (Figures 1 to 5):

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Figure 1: Photographs during R-line transplantation

Figure 2: Photographs after A-line and R-line transplantation of a block

Figure 3: Photographs 45 days after transplantation

Figure 4: Photographs during flowering

Figure 5: Photographs during harvesting of A-lines

Table 4: The simple correlation matrix considering genotypic correlation:

1.00	-0.17	-0.06	1.1	-0.02	-0.11	0.12	0.04	0.04	0.14	0.14	0.07	0.001	-0.03
	1.00	-1.09	0.32	0.7	-0.07	72.5	-0.15	0.17	0.41	0.18	0.29	0.007	-0.09
		1.00	0.098	0.29	-0.11	9.18	-0.1	-0.03	0.09	0.14	-0.005	-0.006	50.18
			1.00	0.89	0.21	2.62	0.17	0.27	-0.03	0.33	0.05	0.06	-0.26
				1.00	-0.51	65.17	0.25	0.27	-0.26	-0.27	0.22	-0.1	0.43
					1.00	58383.58	0.01	0.22	-138.16	-0.007	-0.057	0.017	0.207
						1.00	11.74	12.92	38.8	38.41	-10.84	15.64	-21.82
							1.00	0.22	0.21	0.11	-0.003	0.04	-0.005
								1.00	99.32	0.32	0.13	0	0.12
									1.00	198.48	-7	0.09	0.78
										1.00	0.19	-0.12	-0.36
											1.00	0.11	-0.03
												1.00	-0.14
													1.00

Table 5: The simple correlation matrix considering phenotypic correlation:

1.00	0.39	0.49	0.20	0.65	0.11	-0.99	-0.49	0.02	1.26	0.25	0.77	1.13	3.25
	1.00	1.40	0.22	-0.48	0.11	-10.88	-0.02	0.32	0.05	-0.06	0.12	0.22	1.11
		1.00	0.37	-0.44	-0.27	-14.44	-0.10	0.40	0.63	-0.06	0.05	0.17	758.20
			1.00	0.32	0.89	22.31	-0.05	0.12	0.16	-0.03	0.20	0.32	0.68
				1.00	-0.10	-16.49	0.13	0.14	0.54	0.30	0.15	1.15	3.80
					1.00	-34.70	0.15	0.05	305.03	-0.02	0.07	0.83	0.69
						1.00	-10.35	-7.84	25.50	15.32	8.39	43.60	64.05
							1.00	0.03	0.19	0.05	0.14	-0.22	0.39
								1.00	162.45	0.14	0.27	0.26	1.00
									1.00	218.49	3.62	2.32	0.00
										1.00	0.20	0.35	1.09
											1.00	0.75	0.44
												1.00	2.00
													1.00

Table 6: The simple correlation considering environmental correlation matrix:

1.00	0.19	0.16	0.17	0.22	0.21	0.37	0.43	0.02	0.42	0.12	0.51	0.12	0.40
	1.00	1.04	0.16	-0.49	0.12	-12.10	0.07	0.31	-0.05	-0.04	0.32	0.06	0.37
		1.00	0.29	-0.36	-0.45	-13.00	-0.02	0.39	0.35	-0.07	0.07	0.04	153.93
			1.00	-0.22	-0.03	39.00	-0.24	0.02	0.19	-0.11	0.35	0.09	0.47
				1.00	-0.0024	-19.29	0.16	0.13	0.47	0.32	0.17	0.38	1.11
					1.00	19066.32	0.50	-0.11	533.72	-0.03	0.29	0.45	0.13
						1.00	-26.93	11.88	-25.68	12.89	16.57	11.82	25.55
							1.00	-0.23	0.11	0.06	0.48	-0.23	0.29
								1.00	210.05	0.12	0.44	0.11	0.34
									1.00	155.67	-0.03	0.58	-0.41
										1.00	0.27	0.15	0.47
											1.00	0.27	0.29
												1.00	0.33
													1.00

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