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Influence of Seasons on Seed Quality Attributes of New CMS Lines of Hybrid Rice (*Oryza sativa* L.)

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ABSTRACT

The experiment was conducted at Department of Seed Science and Technology G.K.V.K, U.A.S, Bengaluru. To investigate the "Influence of seasons on seed quality parameters of new CMS lines of hybrid rice (*Oryza sativa* L.)" seven CMS lines and their isogenic maintainers used for quality studies and after harvest seeds were collected from two viz., *kharif* and summer seasons. The seeds were tested for seed quality parameters and observations recorded. The results revealed that, the seasons tested for quality parameters, seeds produced at summer season had better seed quality parameters compared to *kharif* season. Among the CMS lines, highest germination was recorded in KCMS57A (95.33%) in *kharif* season and where as in summer same line recorded (96.33 %) and in maintainer line KCMS54B recorded (93.33%) in *kharif* and in summer same line recorded (93.67%), with respect to the maximum seedling vigor index observed in KCMS59A (4059) and B line KCMS61B (3895) in *kharif* and KCMS57A (4189) and KCMS61B recorded (3941) in summer and lowest observed in KCMS62A (3857 and 3961) in *kharif* and summer respectively. This study concluded that rice seeds produced at summer season recorded highest seed quality than seeds produced at *kharif* season recorded lower seed quality parameters.

Keywords Seed quality, Germination, Root length, Seasons, Total dehydrogenase activity.

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INTRODUCTION

Rice (*Oryza sativa* L. 2n=24) is the most favored food crop of the developing world. It provides up to two third of the calories for more than 60% of the world population. It is the agricultural commodity with the third-highest worldwide production, after sugarcane and maize. China not only developed the world's first commercial rice hybrid, but also optimized technology which made hybrid rice seed

production economically viable. Rice occupies a pride place among food crops cultivated in world. Given that rice is the primary source of income for millions of rural households in India, the campaign's slogan "Rice is Life" is particularly noteworthy. The nation produces 118.43 million tons of rice on an area of 43 million ha, with an average productivity of 2.75 t ha^{-1} (Anonymous 2020).

In India the area under rice hybrid seed production is 2000 hectares with production of 3000 tons with an average productivity of 1.5–2.5 tons ha^{-1} (Rice Knowledge Management Portal-2010, DRR). The task of increasing rice supply to meet the anticipated demand will be difficult without further technological innovation to shift the yield ceilings and their large scale adoption.

Seed is the basic unit of agriculture which gives maximum return in crop production to the farmer seed production, distribution and timely supply of quality seeds are therefore, inevitable to boost the production because no agricultural practice can improve the productivity beyond the limit set by the seed. Seed quality depends on a large number of factors such as environmental, biotic, physical and physiological. Among several factors, uniform stand establishment in the field is the main problem due to non-availability of quality seeds and consequently a reduction in yield. Seed quality plays a vital role for successful crop production. The quality of the seed is generally estimated by its purity health and most importantly, its germination. The seed must be viable and possess physiological quality that allows rapid germination and seedling establishment (Kulakarni *et al*. 2017). The highest quality of the seed is attained under that complex of conditions evoking the most favorable interactions between genetic makeup of a seed and the environment under which it is produced, harvested, processed and stored (Balappa *et al*. 2020). It is essential to make available better quality seed for sowing. Seeds tend to deteriorate even under controlled conditions but at a very slower pace compared to ambient conditions so it is important to check the seed quality parameters for further use. Therefore, the present study was undertaken to evaluate the influence of seasons on seed quality parameters of new CMS and maintainer lines of hybrid rice.

MATERIALS AND METHODS

To study the influence of seasons on seed quality parameters of new CMS lines of hybrid rice freshly harvested rice seeds were collected *kharif* 2019 and summer 2020 seasons. Seeds were cleaned, graded, dried to safe level of moisture and used for the experiment. The initial moisture content of the seeds was in the range of 9 to 10%. In this study, 7 CMS lines and one check (KCMS62A) were evaluated for various quality attributes. The analysis was done by adopting factorial completely randomized design with three replications (Panse and Sukathme 1967).

Germination (%)

The germination test was conducted in four replicates of 100 seeds each by following between paper method and the rolled towels were incubated in the walk-in seed germination room maintained at 25 ± 2°C temperature and 90 ± 5% RH. The number of normal seedlings in each replication was counted on the 14th day and the mean germination was calculated and expressed in percentage (Anon 2013).

$$\text{Germination (\%)} = \frac{\text{No. of normal seedlings germinated}}{\text{Total number of seeds used}} \times 100$$

Root length (cm)

From the germination test, five normal seedlings were randomly selected from each treatment on the day of final count. The root length was measured from the tip of the root to hypocotyl point and the mean length was calculated and expressed in centimeters (Anon 2013).

Shoot length (cm)

From the germination test, five normal seedlings were randomly selected from each treatment on the day of final count. The shoot length was measured from the tip of shoot to hypocotyl point and the mean length was calculated and expressed in centimeters (Anon 2013).

Seedling vigor index

Seedling vigor index was determined by multiplying

percentage germination and mean seedling length (Abdul-Baki and Anderson 1973).

Seedling Vigor Index = Germination (%) × Mean seedling length (cm)

Seedling dry weight (mg)

Five seedlings selected for seedling length measurement were used for recording seedling dry weight. After removing the primary leaf (remnant part), seedlings were dried in hot air oven maintained at 85±20°C for 24 h. The mean seedling dry weight was recorded and expressed in milligrams per seedling.

Electrical conductivity (dSm^{-1}) of seed leachate

Twenty five seeds were taken randomly from each treatment in two replications and soaked in 25 ml of double distilled water for 18 h at 25±1°C. After incubation, the seed leachate was decanted and the electrical conductivity was measured in a digital conductivity meter (Model DI-909) and expressed in dSm^{-1}.

Total dehydrogenase activity (A_{480})

Twenty seeds selected randomly were imbibed for 24 h in between two moist filter papers. The embryonic axes were exercised carefully and soaked with 0.5% Tetrazolium solution in a test tube. These were incubated under dark at 30 ±10°C for a period of 2 h. Then they were washed with distilled water. The red colored formazan was eluted from the stained embryos by soaking in 5 ml of 2 methoxy ethanol for 6 to 8 h in an air tight screw capped vials. The extract was decanted and the color intensity was measured with the help of Spectrophotometer (model Mini spec-17) at 480 nm. The total dehydrogenase activity (TDH) was expressed in terms of absorbance (Franca *et al*. 1998).

RESULTS AND DISCUSSION

Analysis of variance for seed quality traits

The results of analysis of variance carried out for several quality characteristics in seven new WA- CMS lines and their maintainers along with standard check are presented in (Tables 1 and 2). The variance due to replication was non-significant for all the characteristics. Significant differences were observed among A and B lines for all the characters studied except seed germination, electrical conductivity and total dehydrogenase activity during *kharif* 2019 and summer 2020.

Seed germination percentage did not differ significantly. However, only interaction showed significant difference. Among the CMS lines, in *kharif* 2019 highest seed germination was recorded in KCMS57A (95.33) and lowest in KCMS562A (94.67) and remaining lines KCMS53A, KCMS58A and KCMS60A recorded (94.67) and among all maintainer lines, the highest seed germination was recorded in KCMS53B (95.00) and lowest in KCMS54B (94.33). Among the CMS lines in summer 2020 the highest seed germination was recorded in KCMS57A (96.33) and lowest values were recorded in KCMS62A (94.67). Among the maintainer lines, the highest seed germination

Table 1. Analysis of variance for seed quality characters *kharif* 2019.

Source of variation	Df	Germ ination (%)	Root length (cm)	Shoot length (cm)	Seedling vigor index	Electrical conductivit C (dSm^{-1})	Seedling dry weight (g)	Total dehydr ogenase activity (OD value)
Replication	2	0.52	0.03	0.00	188.12	26.063	0.305	0.014
Treatments	15	0.72	0.48**	0.06**	843.05**	31.754	0.214**	0.018
A lines	7	0.18	0.47**	0.07**	715.68**	38.280	0.279	0.008
B lines	7	0.86	0.09**	0.03	572.88	29.619	0.175	1.270
A vs B lines	1	3.52**	3.30**	0.25**	3625.82**	1.021	0.035	0.018
Error	30/7	0.39	0.08	0.03	362.29	26.729	0.102	0.019

Table 2. Analysis of variance for seed quality characters summer 2020.

Source of variation	Df	Germ ination (%)	Root length (cm)	Shoot length (cm)	Seedling vigiur index	Electrical conductivit C (dSm^{-1})	Seedling dry weight (g)	Total dehydr ogenase activity (OD value)
Replication	2	0.33	0.19	0.06	774.33	8.90	0.02	0.02
Treatments	15	1.00**	0.56**	0.03	992.45**	23.11	0.03**	0.01
A lines	7	0.74	0.77**	0.03	1223.13**	25.61	0.02	0.01
B lines	7	0.90	0.07	0.02	350.07	23.71	0.04**	0.01
A vs B lines	1	3.52**	2.57**	0.11	3874.33**	1.33	0.08	0.03
Error	30/7	0.38	0.14	0.03	276.24	13.72	0.01	0.01

was recorded in KCMS57B (95.33) and KCMS53B (95.33) and lowest was observed in KCMS54B (93.67).The highest seed germination may be attributed to better seed quality and seedling length (Table 3).

Root length differed significantly for all CMS lines during both the seasons. Among the CMS lines in *kharif* 2019 highest root length was recorded in KCMS58A (22.26 cm) and lowest values were recorded in KCMS53A (21.34 cm) and among all maintainer lines, highest root length was recorded in KCMS57B (21.62 cm) and lowest was observed in KCMS61B (21.09 cm). Among the CMS lines, in summer 2020 the highest root length was recorded in KCMS57A (22.82 cm) and lowest values were recorded with KCMS62A (22.36 cm) and among the maintainer lines, highest root length was recorded in KCMS57B (21.81 cm) and lowest was observed in KCMS53B 21.38 is cm (Table 3). Shoot length (cm) did not differ significantly for all CMS lines during both the seasons. Among the CMS lines in *kharif* 2019, the highest shoot length was recorded in KCMS54A (20.77 cm) and lowest values were recorded in KCMS53A (20.26 cm) and among the maintainer lines the highest shoot length was recorded in KCMS54B (20.49 cm) and lowest was observed in KCMS59B (20.19 cm). Among the CMS lines in summer 2020, the highest shoot length was recorded in KCMS54A (20.74 cm) and lowest values were recorded in KCMS53A (20. 48 cm) and among the maintainer lines, highest shoot length was recorded in KCMS54B (20.63 cm) and lowest was observed in KCMS62B is 20.41cm (Table 4).

Seedling dry weight did not differ significantly for all CMS lines during both the seasons. Among the CMS lines, in *kharif* 2019, highest seedling dry weight was recorded in KCMS60A (6.14 mg) and lowest values were recorded in KCMS58A (5.27 mg) and among all maintainer lines, highest seedling

Table 3. Mean performance of seed quality characteristics of rice hybrid parental lines during *kharif* 2019 and summer 2020 season.

CMS lines	B lines	Germination (%)				Root length (cm)			
		kharif 2019		Summer 2020		*kharif* 2019		Summer 2020	
		A	B	A	B	A	B	A	B
KCMS57A	KCMS57B	95.33	94.67	96.33	95.33	22.19	21.62	22.82	21.81
KCMS53A	KCMS53B	94.67	95.00	95.00	95.33	21.34	21.15	21.63	21.38
KCMS58A	KCMS58B	94.67	94.67	95.00	94.67	22.26	21.14	22.37	21.29
KCMS59A	KCMS59B	95.00	94.33	95.33	95.00	22.14	21.13	22.25	21.43
KCMS60A	KCMS60B	94.67	94.67	95.00	94.67	21.59	21.20	21.92	21.53
KCMS61A	KCMS61B	95.00	94.00	95.33	94.33	21.63	21.09	21.69	21.39
KCMS54A	KCMS54B	95.00	93.33	95.33	93.67	21.40	21.26	21.44	21.52
KCMS62A	KCMS62B	94.67	94.00	94.67	94.67	21.36	21.12	21.36	21.44
Grande mean		94.88	94.33	95.25	94.71	21.74	21.21	21.94	21.47
SEm ±		0.32	0.40	0.36	0.33	0.22	0.10	0.16	0.25
CD (P=0.05)		0.97	1.22	1.11	1.00	0.67	0.29	0.50	0.76
CV (%)		0.59	0.74	0.66	0.60	1.77	0.78	1.29	2.03

Table 4. Mean performance of seed quality characteristics of rice hybrid parental lines during *kharif* 2019 and summer 2020 season.

CMS lines	B lines	Shoot length (cm)				Seedling vigor index			
		kharif 2019		Summer 2020		*kharif* 2019		Summer 2020	
		A	B	A	B	A	B	A	B
KCMS57A	KCMS57B	20.38	20.26	20.67	20.56	4058	3965	4189	4038
KCMS53A	KCMS53B	20.26	20.36	20.48	20.45	3937	3943	4001	3987
KCMS58A	KCMS58B	20.48	20.38	20.64	20.57	4045	3930	4085	3962
KCMS59A	KCMS59B	20.59	20.19	20.55	20.47	4059	3897	4080	3980
KCMS60A	KCMS60B	20.47	20.21	20.58	20.43	3981	3920	4038	3973
KCMS61A	KCMS61B	20.38	20.35	20.51	20.39	3990	3895	4023	3941
KCMS54A	KCMS54B	20.77	20.49	20.74	20.63	4006	3896	4021	3947
KCMS62A	KCMS62B	20.44	20.37	20.48	20.41	3857	3899	3961	3961
Grand mean		20.47	20.33	20.58	20.49	4004	3918	4050	3974
SEm ±		0.06	0.13	0.09	0.11	32.59	23.16	23.18	27.24
CD (P=0.05)		0.18	0.39	0.26	0.34	98.85	70.24	70.31	82.61
CV (%)		0.49	1.09	0.72	0.95	1.41	1.02	0.99	1.19

dry weight was recorded in KCMS59B (6.02 mg) and lowest was observed in KCMS58B (5.30 mg). During summer 2020, among the CMS lines, highest Seedling dry weight was noticed in KCMS60A (6.26 mg) and lowest values were recorded in KCMS58A (6.00 mg) and among all maintainer lines, highest seedling dry weight was observed in KCMS60B (6.16 mg) and lowest was observed in KCMS58B is 5.77 mg (Table 5).

Seedling vigor index differed significantly for all CMS lines during both the seasons. During *kharif* 2019, among the CMS lines, maximum seedling vigor index exhibited in KCMS59A (4059) and lowest values were recorded in KCMS53A (3937) and among all maintainer lines, the maximum seedling vigor index was recorded in KCMS57B (3965) and minimum was observed in KCMS61B (3895). During Summer2020, among the CMS lines, the highest seedling vigor index was seen in KCMS57A (4189) and lowest values were recorded (Table 4) in KCMS53A (4001) and among all maintainer lines, highest seedling vigor index was recorded in KCMS57B (4038) and lowest was manifested in KCMS61B (3941).

Electrical conductivity of seed leachate did not differ significantly among all the CMS lines during both the seasons. During *kharif* 2019, among the CMS lines the highest electrical conductivity of seed leachate was noticed in KCMS58A (56.67 dSm^{-1}) and lowest values were recorded in KCMS60A (46.33 dSm^{-1}) and among all maintainer lines, the highest

Table 5. Mean performance of seed quality characteristics of rice hybrid parental lines during *kharif* 2019 and summer 2020 season.

CMS lines	B lines (dSm^{-1})	Electrical conductivity				Seedling dry weight (g)				Total dehydrogenase activity (OD value)			
		kharif 2019		Summer 2020		*kharif* 2019		Summer 2020		*kharif* 2019		Summer 2020	
		A	B	A	B	A	B	A	B	A	B	A	B
KCMS57A	KCMS57B	48.00	49.33	46.33	48.33	6.08	5.59	6.14	6.11	1.19	1.24	1.28	1.27
KCMS53A	KCMS53B	49.67	51.00	48.33	49.67	5.47	5.56	6.11	6.07	1.18	0.94	1.21	1.07
KCMS58A	KCMS58B	56.67	55.33	53.33	52.33	5.27	5.30	6.00	5.77	1.03	1.05	1.15	1.12
KCMS59A	KCMS59B	47.67	48.00	46.00	46.67	5.73	6.02	6.06	6.01	1.11	1.19	1.18	1.17
KCMS60A	KCMS60B	46.33	46.67	45.00	45.67	6.14	5.92	6.26	6.16	1.11	1.04	1.13	1.06
KCMS61A	KCMS61B	45.00	45.67	44.00	44.67	5.98	5.68	6.09	6.02	1.18	1.14	1.17	1.15
KCMS54A	KCMS54B	48.33	48.33	46.00	45.67	5.66	5.77	6.10	6.09	1.10	1.04	1.12	1.08
KCMS62A	KCMS62B	46.67	46.33	45.33	44.00	5.90	5.96	6.13	6.02	1.15	1.10	1.19	1.14
Grand mean	48.54	48.83	46.79	47.13	5.78	5.72	6.11	6.03	1.13	1.09	1.18	1.13	
SEm ±		2.92	3.24	1.90	2.45	0.21	0.16	0.07	0.07	0.08	0.08	0.05	0.05
CD (P=0.05)		8.87	9.82	5.78	7.43	0.63	0.49	0.20	0.22	0.23	0.26	0.14	0.15
CV (%)		10.43	11.48	7.05	9.00	6.20	4.92	1.88	2.11	11.78	13.37	6.85	7.79

electrical conductivity of seed leachate was recorded in KCMS58B (55.33 dSm^{-1}) and lowest was observed in KCMS61B (45.67 dSm^{-1}). During summer 2020, among the CMS lines, the highest electrical conductivity of seed leachate was recorded in KCMS58A (53.33 dSm^{-1}) and lowest values were recorded in KCMS61A (44 .00 dSm^{-1}) and among all maintainer lines, the maximum electrical conductivity of seed leachate was recorded in KCMS58B (52.33 dSm^{-1}) and minimum was observed in KCMS61B (44.67 dSm^{-1}) (Table 5).

Total dehydrogenase activity did not differ significantly for all CMS lines in both the seasons. During *kharif* 2019, among the CMS lines, the highest total dehydrogenase activity was exhibited in KCMS57A (1.19) and lowest values were recorded in KCMS58A (1.03) and among all maintainer lines, the total dehydrogenase activity was recorded in KCMS57B (1.24) and lowest was observed in KCMS53B (0.94). During summer 2020, among the CMS lines, the highest total dehydrogenase activity was recorded in KCMS57A (1.19) and lowest values were recorded in KCMS54A (1.12) and among all maintainer lines, highest total dehydrogenase activity was noticed in KCMS57B (1.27) and lowest was observed in KCMS60B (1.06) (Table 5).The seed quality attributes differed significantly due to production seasons. The seeds produced during summer 2020 season exhibited superior seed quality parameters over the seeds produced during *kharif* 2019. Similar results were also reported by (Fernandes *et al*. 1980, Takahashi *et al*. 1987 and Deshpande 1993). The kharif season yielded poor quality seeds with higher electrical conductivity values due to inferior crop growth and reproductive performance in view of the prevalence of adverse weather conditions. Similar variable effects of different seasons on seed quality by (Solanki and Gupta 2000).

CONCLUSION

In a nutshell the study concluded that hybrid rice seed production of CMS lines and their maintainer lines seed multiplication can be taken up during *rabi*/ summer than *kharif* to produce the high quality seeds.

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REFERENCES

Abdul-Baki AA, Anderson JD (1973) Vigor determination by multiple criteria. *Crop Sci* 13: 630-637.

Anonymous (2020) Annual Report (2020) ICAR-NRRI, pp 85.

Anonymous (2013) International rules for seed testing. *Seed Sci Technol* 24: 23-46.

Balappa Sattigeri Parashivamurthy Siddaraju R, Harish MS (2020) Effect of seed production locations on seed quality and storabillty in rice (*Oryza sativa* L.) hybrid KRH-4. *J Phar Phyto* 9(1): 120-122.

Deshpande VK (1993) Effect of provenance, method of propagation and technique of seed production on seed yield and quality of hybrid rice (*Oryza sativa* L.). PhD thesis. *Uni Agric Sci Bangalore*.

Fernandes GMB, Oliveira ABD, Amorium neto S (1980) Evaluation of seed quality of rice as a function of sowing date. *Rice Abstracts* 4: 207.

Franca NJB, Krzyzanowsk FC, Costa NP (1998) The tetrazolium-test for soybean seeds. Comstock publishing Associates, London, pp 71-115.

Kulkarni CC, Monalisa SK, Swain Behera M (2017) Effect of growing season on the seed quality attributes of sesamum genotypes. *Int J Curr Microbiol Appl Sci* 6(9): 293-301.

Panse VG, Sukhatme PV (1967) Statistical Methods for Agricultural Workers," 2nd edn. Indian Council of Agricultural Research, New Delhi.

Solanki ZS, Gupta D (2000) Genotype x environment interaction study for seed yield in sesame. *J Oilseeds Res* 17(1): 29-31.

Takahashi N, Choi KS, Sato T (1987) After effects of parental exposure of temperature on seed germination and seedling growth production. *J Appl Seed Prod* 5: 61.