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Response of rice varieties (*Oryza sativa* L.) to accelerated ageing of seeds

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Abstract
Response of five rice varieties viz. Sali, Thailand Lahi, MTU – 7029, MTU – 1010 and Khamti Lahi to accelerated ageing of seeds was studied involving two temperatures and two duration's i.e 45 ^{0}C and 60 ^{0}C for 24 hrs and 36 hrs along with an untreated control during April 2019 at Arunachal University of Studies, Namsai. Various seed quality parameters such as germination percentage, speed of germination, vigour index, seedling dry weight and seedling length were observed. The study concluded that artificial ageing treatments involving a temperature of 45 ^{0}C was found to have a significant positive effect on the seed germination and vigour parameters, while temperature of 60 ^{0}C adversely affected the germination and seed quality parameters. With increase in duration of artificial ageing the seed quality parameters were found deteriorated. Among the five varieties tested, Thailand Lahi was found as the most superior variety and was highly tolerant to accelerated ageing treatments followed by MTU – 1010 and Sali which were at par with each other. Khamti Lahi was found to have the lowest germination and vigour parameters indicating its high sensitivity and low tolerance to accelerated ageing. The study indicates superiority of Thailand Lahi, MTU – 1010 and Sali for better storage life of seeds, having comparatively a slow ageing process.

Keywords: accelerated ageing, artificial ageing, rice varieties, germination and seed quality

Introduction
Rice is one of the chief food grains of India, and it is the staple food of North East India, particularly in Arunachal Pradesh. Rice being the staple food crop of Arunachal Pradesh is grown in almost all the districts. Itanagar, Gegong, Ranjit, Boro, CAU R1, Khamti Lahi, Sali etc are some of the rice varieties grown in the State.
Productivity of the crop depends on the quality of seeds, among other factors like soil, climatie and management. In Arunachal Pradesh, normally only one crop (Kharif) is taken. Storage capacity of rice varities becomes important in such conditions, where farmers need to store for about 5 – 6 months. Seed deterioration, a natural process is expressed as the loss of quality, viability, and vigour during ageing or storage period and it is enhanced during adverse environmental conditions. It is an irreversible degenerative process that occurs during storage. Seed deterioration results in is reduced germinability and many tests for measuring the loss in vigour have been developed based on the physiological effect of ageing (ISTA 1999; Jatoi *et al.*, 2004) [5]. Among them, the most important method is accelerated ageing which is done by subjecting seeds to elevated temperature and high relative humidity.
A large number of rice varieties are cultivated by farmers and it would be necessary to assess the genetic variations associated with the ageing. Artificial ageing techniques are adopted to assess the storability of varieties and seed lots under laboratory conditions. However information on the effect of artificial ageing on seed quality parameters on rice varieties grown in Arunachal Pradesh is still lacking. Hence an attempt was made to study the variations in seed senescence of common paddy varieties (*Oryza sativa* L.) of Arunachal Pradesh

Materials and Methods
The present investigation was conducted during the Zaid season month of April 2018 -19 in the Agriculture laboratory of Arunachal University of Studies, Namsai. Paddy seeds harvested in January 2019, from experimental field of AUS from five varieties viz. MTU – 1010, MTU – 7029, Khamti Lahi (local variety), Sali (local variety) and Thailand Lahi (Exotic variety) grown under uniform conditions in kharif 2018 season were dried to 12% moisture and subjected to desiccators – hot air oven method of artificial ageing.

Seed samples (50 g) from each variety were packed in cloth bag and subjected to accelerated ageing treatments for two durations (24 and 36 hours) and at two temperatures (45 ^{0}C and 60 ^{0}C). Thus, there were five treatments, including untreated control. The artificially aged seeds were evaluated for seed quality parameters. The experiment was conducted in a completely randomized design with three replications. Germination percentage, speed of germination, seedling length, seedling dry weight and speed of germination were recorded. The data were subjected to statistical analysis.

Results and Discussion

Overall mean of varieties and treatments on seed germination and vigour parameters, along with results of statistical analysis are furnished in the table 1.

Germination percentage

Statistical analysis showed significant variations for seed germination among the treatments Germination percent among the treatments varied from 0% to 93.4%. The overall germination of varieties varied from 4.47% (lowest) in Khamti Lahi to 53.57% (highest) in Thailand Lahi and MTU – 7029. The overall mean germination of seeds under different artificial ageing treatments varied significantly and it ranged from 0.89% at T4 (ageing @ 60 ^{0}C for 36 hours) to 73.4% at T1 (ageing @ 45 ^{0}C for 24 hours). It was further observed that the varietal X treatment interactions also differed significantly different with respect to germination and it ranged from 0% under T3 (ageing @ 60 ^{0}C for 24 hours) and T4 (ageing @ 60 ^{0}C for 36 hours) in case of Sali, Thailand Lahi, MTU -7029 and Khamti Lahi. However, some germination under MTU -1010 was observed under T3 (ageing @ 60 ^{0}C for 24 hours - 16.67%) and T4 (ageing @ 60 ^{0}C for 36 hours - 4.47%).

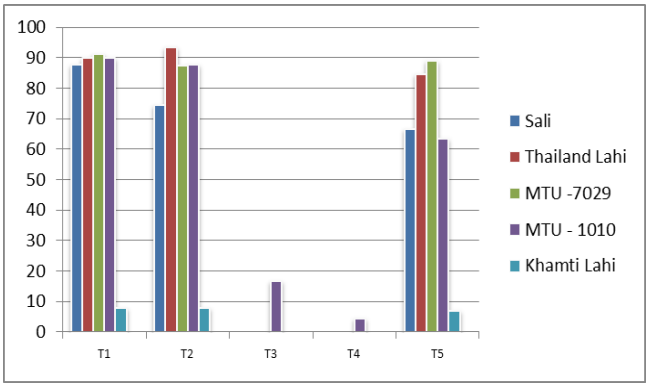

Fig 1: Germination percent

Germination percentage of artificially treated seeds at lower temperature of 45 ^{0}C was found to be higher than that of control seeds. Germination percent decreased with increase in ageing duration and temperature, similar results on artificial ageing were observed in germination percentage by Rao *et al.*, (1994) [12], Sung and Jeng, (1994) [14] in peanut, Khan *et al.*, (1998) [9] in cotton, Singh *et al.*, (2003) [13] in urd bean and mung bean,

The overall varietal mean for Khamti Lahi being 4.47% was found to be significantly lower and distinctly different than other varieties

Table 1: Overall mean effect of rice varieties and ageing techniques on seed quality parameters of rice varities.

	Germination %	Speed of germination	Seedling dry weight	Vigour index I	Vigour index II	Shoot length	Root length	Total seedling length
Overall mean of Varieties								
Sali	45.8	2.34	0.13	1155.84	1.02	6.98	8.12	15.12
Thailand Lahi	53.57	3.7	0.13	1497.86	1.14	8.76	7.99	16.76
MTU – 1010	53.57	3.15	0.11	1278.89	1.05	6.53	7.76	14.29
MTU – 7029	52.47	3.17	0.33	1107.79	1.26	8.64	10.79	19.47
Khamti Lahi	4.47	0.17	0.13	91.36	0.07	4.72	6.12	10.79
CD (P = 0.01)	21. 58	1.37	N.S	545.71	0.43	N.S	N.S	N.S
Overall mean of Treatments								
45 ^{0}C for 24 hrs	73.4	4.33	0.24	1897.98	1.55	11.74	13.25	25.12
45 ^{0}C for 36 hrs	70.19	4.15	0.21	1711.51	1.49	11.43	12.8	24.18
60 ^{0}C for 24 hrs	3.334	0.21	0.03	78.35	0.068	1.39	1.73	3.14
60 ^{0}C for 36 hrs	0.89	0.04	0.024	20.5	0.016	1.29	1.76	3.06
Control	62.04	3.81	0.33	1423.4	1.41	9.76	8.16	20.91
CD (P = 0.01)	21.58	1.37	N.S	545.71	0.43	3.32	4.07	7.22
CD for interaction (P = 0.01)	48.25	2.95	N.S	1220.25	0.97	7.42	N.S	16.66

Speed of germination

Speed of germination among the treatments varied from 0 to 6.26 (seeds/ day). The overall germination speed of varieties varied from 0.17 seeds/ day (lowest) in Khamti Lahi to 3.7 seeds/ day (highest) in Thailand Lahi. The overall varietal mean for Khamti Lahi (0.17 seeds/ day) and Sali (2.34 seeds/ day) was found to be significantly lower and distinctly different than other varieties.

Seedling dry weight

Seedling dry weight among the treatments varied from 0 to 0.93 g. The overall seedling dry weight for varieties varied from 0.11 g (lowest) in MTU – 7029 to 0.33 g (highest) in MTU – 1010. The overall mean germination of seeds under different artificial ageing treatments from 0.03 g at T3 (ageing @ 60 ^{0}C for 24 hours) to 0.33 g at T5 (control). As per the findings of Verma *et al.* (2003) [15, 16] the dry weight of seedling is decreased as the ageing period increased in mustard.

Vigour Index

Vigour Index I among the treatment varied from 0 to 2634.97. The overall Vigour Index I of varieties varied from 91.36 (lowest) in Khamti Lahi to 1497.86 (highest) in Thailand Lahi.

Vigour Index II among the treatments varied from 0 to 1.97. The overall vigour Index II of varieties varied from 0.07(lowest) in Khamti Lahi to 1.26 (highest) in MTU –

1010.The overall varietal mean for vigour index II in Khamti Lahi being 0.07 was found to be significantly lower and distinctly different than other varieties. The overall mean vigour index II under different artificial ageing treatments varied significantly and it ranged from 0.016 at T4 (ageing @ 60 ^{0}C for 36 hours) to 1.55 at T1 (ageing @ 45 ^{0}C for 24 hours.

Singh *et al.,* (2003) [13] reported that seed vigour index decreased significantly with increasing ageing duration in urd bean and mund bean, similar observations were reported Verma *et al.,* (2003) [15, 16] in mustard, Pallavi *et al.,* (2003) [11] in sunflower, Khan *et al.,* (2005) [8] in cotton and Gupta *et al.,* (2005) [4] in pearl millet.

Root length and shoot length (cms) on 14th day (final count day)

The root length among the treatments varied from 0 cm to 13.92 cm. The overall shoot length of varieties varied from 6.12 cm (lowest) in Khamti Lahi to 10.79 cm (highest) in MTU – 1010. The overall mean root length of seeds under different artificial ageing treatments varied significantly and it ranged from 1.73 cm at T4 (ageing @ 60 ^{0}C for 36 hours) to 13.25 cm at T1 (ageing @ 45 ^{0}C for 24 hours).

Shoot length among the treatments varied from 0 cm to 15.7 cm. The overall shoot length of varieties varied from 4.72 cm (lowest) in Khamti Lahi to 8.76 cm (highest) in Thailand Lahi.It was further observed that the varietal X treatment interactions were significantly different with respect to shoot length and it ranged from 0 cm under T3 (ageing @ 60 ^{0}C for 24 hours) and T4 (ageing @ 60 ^{0}C for 36 hours) in case of Sali, Thailand Lahi, MTU -7029 and Khamti Lahi. However, shoot length under MTU -1010 was observed under T3 (ageing @ 60 ^{0}C for 24 hours – 6.99 cm) and T4 (ageing @ 60 ^{0}C for 36 hours – 6.47 cm).

Total seedling length (cms) on final day

Total seedling length among the treatments varied from 0 cm to 29.27 cm. The overall shoot length of varieties varied from 10.79 cm (lowest) in Khamti Lahi to 29.27 cm (highest) in Thailand Lahi.

The overall mean total seedling under difference artificial ageing treatments varied significantly and it ranged from 3.06 cm at T4 (ageing @ 60 ^{0}C for 36 hours) to 25.22 cm at T1 (ageing @ 45 ^{0}C for 24 hours).

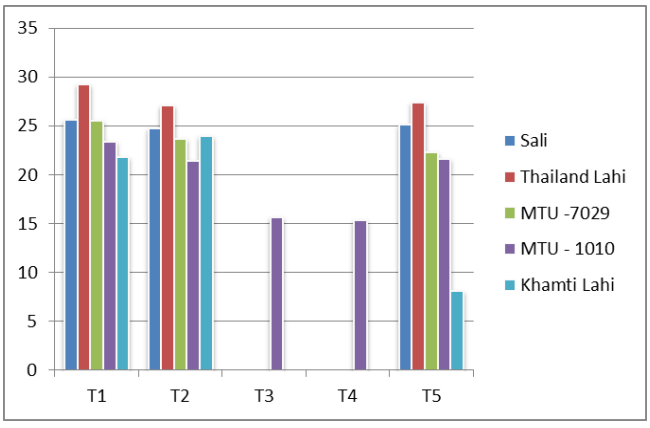

Fig 2: Total seedling length

Seedling length decreased with increase in accelerated ageing treatments, similar results were observed in seedling length by Singh *et al.* (2003) [13] in urd bean and mung bean, Verma *et al.,* (2003) [15, 16] in mustard, Pallavi *et al.,* (2003) [11] in sunflower, Gupta *et al.,* (2005) [4] in pearl millet, Kapoor *et al,* (2010) [7] in Chick pea, Dharmalingam and Basu, (1978) [2]; Khan *et al.,* (1998) [9].

Conclusion

From the findings of present investigation, it could be inferred that artificial ageing treatments involving a temperature of 45 ^{0}C was found to have a significant effect on seed quality parameters under cool winter atmospheric conditions. With increase in duration of artificial ageing the seed quality parameters like germination percentage, speed of germination, seedling dry weight, seed vigour and seedling length decreases with increase in time of artificial ageing. Thailand Lahi appeared to be the most tolerant variety for ageing conditions and its performance was consistently superior to that of the other varieties, followed by MTU – 1010 and Sali and these were at par with each other. Khamti Lahi was found to be the inferior variety with respect to seed quality parameters. This indicates better longevity or storability of Thailand Lahi seeds.

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