ABSTRACT

In the Darjeeling Hills, the cultivation of aromatic rice is indigenous and organic by default. Rice is known as "dhan" in the local language (Nepali). Based on indigenous farmers' perceptions, traditional landraces, commonly grown local cultivars, have superior traits in terms of survival, seed care, and harvest joy.

The experiment for 0-, 90-, 180-, 270-, and 360-day long-term accelerated ageing (95% RH, 2–18°C) was related to a proportionate loss in proteins, RNA, insoluble carbohydrate, and dehydrogenase enzymes in the seed kernels of aromatic rice as well as a decrease in the TTC-stained seed percentage. Control samples with the identical seed materials under long-term accelerated ageing (95% RH, 2–18ºC) showed dramatic alterations, and all of the seed samples were attacked by storage fungi of various species.

The ASA pretreatment, SADH pretreatment, and Na-dikegulac (2,3,4-6-di-O-isopropylidene-L-xylo-2, hexalophuranosate) pretreatment of seeds significantly controlled the decrease in levels of certain vital cellular components such as carbohydrates, protein, RNA, DNA, and dehydrogenase enzymes as well as the TTC-stained percentages. This research has shown the long-term accelerated ageing experiment to be critical to increasing ageing damage in control seeds. The results of this study have shown that chemical pretreatment is effective in accelerating ageing damage in the overall cellular metabolism, providing substantial alleviation. In comparison to the ASA, SADH, and the NaDK, they have been conclusively proved more effective in the accelerated ageing experiments of this investigation.

The percentage germination of rice seeds steadily decreased as accelerated ageing (95% RH, 2-18ºC) progressed from 0-, 90-, 180-, 270-, and 360-days, regardless of the concentration of chemical pretreated samples or control samples. The decline in seed germination was, however, significantly more apparent in the control set. All chemical concentrations effectively slowed down germination, and in the latter observational periods, the impact of NaDK was shown to be significantly more important. The parallel suppression of the field emergence of seed in both the control and chemical pre-treated seed samples was connected with the ageing-inducing reduction in seed germination. Seed pretreatment with chemicals, on the other hand, partially mitigated the ageing-induced impairment of field emergence.

As a result of the 360-days of accelerated ageing, the loss of seed germination and field emergence ability led to a significant slowdown in the speed of germination in both control and chemically pre-treated aged samples. This is demonstrated by the fact that, even after a 172-hour germination time, almost no seeds germinate. In controlled seed lots under accelerated ageing conditions, the pace of germination was found to have significantly slowed down with increasing age. On the other hand, the pretreated chemicals ASA, SADH, and NaDK, however, have been proven to withstand the harmful effects of accelerated ageing and retain germination speed in the seed lots. The accelerated ageing treatment had a significant inhibitory effect on seed germination behavior. Seed pretreatment with NaDK prior to accelerated ageing treatment was shown to partially counteract this inhibitory effect.

The metabolism status of the seeds was also altered, as evidenced by alterations in nucleic acids, soluble carbohydrates, amino acids, and the activity of dehydrogenase, amylase, IAA, catalase, and protease enzymes inside the seeds. Regardless of control or chemically pretreated seed samples, DNA levels in seed cotyledons were shown to decrease as ageing time increased. However, in chemical pretreated samples, the degree of the decrease was significantly less, and yet, with the progression of ageing time in chemical pretreated seed samples, decreasing RNA levels were also discovered. The quantities of carbohydrate, amino acids, dehydrogenase, and catalase in seed ageing decreased over time in control samples, but this tendency was somewhat stopped by the pretreating chemicals. In chemical pretreated seed samples, the activity of soluble carbohydrate, IAA, and protease enzymes increased with the seed ageing process throughout the observation periods. However, in seeds that were pretreated with Na-dikegulac, the rate of increasing activity was observed to be modest. Amylase activity, on the other hand, steadily decreased with seed age.The speed of decreasing enzyme activity was slowed down by Na-Dikegulac.

Plant growth and development were hampered when plants were produced from seeds that had undergone an accelerated ageing treatment (95% RH, 2-18^{o}C) for 360 days. Plant height, stem circumference, dry matter content of intact plants, and plant growth phases are all inhibited by ageing. As seen by substantially higher values of the growth performance recorded at seedling stage, total seed development on panicle, fully filled grain, and seed pretreatment with ASA, SADH, and Na-dikegulac, at least partially alleviated such an ageing-induced inhibitory effect on growth performance. Regardless of the decreasing

activity of enzymes, it has been determined that Na-dikegulac is more effective and provides better results than control, ASA, and SADH.

Some vital cellular components in leaves, such as RNA and soluble carbohydrates, as well as the activities of catalase, superoxide dismutase, IAA-oxidase, RNAse, and protease enzymes, were clearly reflected in plant metabolism as an accelerated ageing-induced hindrance on plant growth performance in the field.

All five developmental stages, pre-flowering stage (P), flowering stage (F), seed forming stage (S), seed maturation stage (M), and pre-harvesting stage (H), of plants produced from seeds that were subjected to an accelerated ageing treatment for 360 days showed significant reductions in DNA, and soluble carbohydrate levels in leaves decreased first in three subsequent sampling periods (P, F, and S). However, there was a sharp rise in the next two following stages (M and H). The result was in contrast to RNA and insoluble carbohydrate levels. The chemical relief of such an inhibitory impact on plant metabolism was obvious by arresting the decline in DNA and maintaining the levels of soluble and insoluble carbohydrates and RNA concentrations in leaves. In addition, the chemical effectively decreased the age-related loss of catalase and superoxide dismutase enzyme activities in leaves, as well as the greater activities of the catabolic enzymes IAA-oxidase and protease.

Accelerated ageing of seeds has led to a delay in the growth and development of plants, which has led to an extension of the life cycle. This slowed overall growth and was visible at every step of plant development studied, including radical emergence, leaf emergence, internodal elongation, and so on. Crop production was affected by changes in the general metabolic status of seeds, seedling development, and plant metabolism, as evidenced by assessments of some yield variables such as total filled seeds per panicle and 1000 seed weight. Seeds that were subjected to an accelerated ageing treatment performed poorly in the field and had low growth potential, particularly in control plants. As a result of the slow overall plant development, crop output was harmed, as seen by the decrease in total seed yield per plant, total filled seeds per panicle, and 1000 seed weight. In comparison to control seed lots, which had received previously accelerated ageing treatment, the pre-treating chemicals, regardless of their concentration, demonstrated better germination percentages. Na-dikegulac efficiently improved harmful effects on the behaviour of germination of seed,

seedling development, and metabolism, as well as accelerated harmful effects generated by ageing on seed.

The positive effect on germination behaviour *was* induced by chemical pretreatment under stressful conditions, i.e., accelerated ageing was clearly evident in seedling development and metabolism. This was apparent because the chemical NaDK significantly induced larger seedlings and dry matter content of undamaged seedlings, the stopping of amylase and protein loss, and the activity of catalase and superoxide dismutase enzymes in contrast to control and other chemicals.

The difficulty of the vigour tests and ageing changes has been to establish quantifiable parameters common to deteriorating seeds depending on their ageing, variations between crops or circumstances of harvesting. There has also been a thorough examination of factors linked to rice seed quality in terms of accelerated ageing and varietal variations in the rice seed longevity stored in ambient settings. As a result, it was deemed necessary to explore physiological and biochemical alterations in order to comprehend the causes of seed deterioration. This helps discover not just causes to improve seed storage, but also details to help incorporate features to improve the storage quality of high-performance varieties. Thus, the present investigation was aimed at investigating various physiological and biochemical changes during seed deterioration as a result of accelerated ageing as well as finding the superior variety among five experimental varieties of rice (*Oryza sativa* L.) and the favourable benefits of Na-dikegulac on maintaining increased seed storage potential, seedling performance, plant field performance, and plant tolerance to harsh environments are described.