SUMMARY
&
CONCLUSIONS
The present study entitled “Studies on physiological, biochemical and nutritional characteristics of Cowpea (Vigna unguiculata L.) seeds during ageing” was conducted during the years 2009-2012 at Germplasm Conservation Division, National Bureau of Plant Genetic Resources, New Delhi. The experimental work was done in the Seed Physiology, Biochemistry and DNA Fingerprinting Laboratories of NBPGR. This study was an attempt to investigate the physiological, biochemical and nutritional aspects of the effect of ageing on cowpea seeds, which are desiccation-tolerant and therefore orthodox in behaviour. Seeds were subjected to controlled deterioration for durations ranging from 24 to 168 h (7 days) and different vigour categories were identified. These were further analyzed for various biochemical, cytological, nutritional and anti-nutritional parameters to identify definite indices for seed-quality loss.

The results clearly brought out cultivar differences in response to ageing. Variety V240 was the best among the three, which withstood the harsh environment of high temperature and high humidity, to which the seeds were exposed during the controlled ageing. The poorest, however, was V578, which had undergone considerable deterioration during the same period of exposure to such conditions. The pigmented seed coat of V240 might have contributed at least partially to the stress-withstanding capacity of this variety.

Seeds subjected to 24 h of ageing exhibited increase in germination percentage, seedling vigour and vigour index, which may be due to an effect similar to priming during the initial durations of ageing, when the metabolic events had commenced within a few hours of exposure to high temperature and high moisture and proceeded till the seeds were removed after a day and the deterioration had not set in yet.

Further ageing beyond 24 h resulted in loss of seed viability accompanied with loss of seed vigour, as seen by the decreased % of vigorous seedlings with increased ageing duration. This was characterized by the occurrence of increased proportion of less vigorous and abnormal seedlings in all the varieties. As the vigour decreased, the germination was delayed and staggered. This in turn led to conspicuous decrease in root length, shoot length, seedling vigour index, seedling weight, and seedling-vigour index I as well as II.
Deficiency in the membrane integrity of the aged seeds was visualized from higher electrical conductivity values of leached electrolytes. Electrical conductivity was found to be a good indicator of seed deterioration as it is a non-destructive method of assessment of seed quality. A high positive correlation between EC and various seed quality parameters existed in all the three varieties. The seeds used for EC measurement can be reused for other parameters or stored after decreasing the moisture content to original.

Among the various biochemical parameters studied, a clear relationship was seen between the activities of several key enzymes and the vigour levels of cowpea seeds. Reserve mobilizing enzymes, viz. amylases and phosphatases, are important for providing respiratory substrates and respiratory enzymes, i.e. dehydrogenase, which provide energy to the germinating seeds, showed a gradual and steady decline, in all vigour lots. The activities of antioxidant enzymes, viz. SOD, CAT and POX, were higher in the high vigour seed lots, compared to the medium and low vigour lots.

A parallel change that was observed in the present study was the corresponding increase in the lipid-peroxidation value, as the vigour of the lots decreased. The study indicates the possibility of radical damage, resulting in decline in fatty-acid content and the corresponding increase in the permeability of the plasma membrane, which correlated well with increased electrical conductivity as well as UV absorbance of seed leachates in low-vigour seeds.

Among the three varieties the highest protein content was registered in V 240, followed by V 585, and the least in V 578. In V 240 and V 585, the protein content was at par with the control, while it decreased in V 578. In the medium and low vigour lots the protein content decreased in all the varieties. The carbohydrate content, on the other hand, exhibited decrease in all the vigour categories including high vigour lots in all the three varieties.

There was an overall increase in the major saturated fatty acids with seed quality depletion and this trend was similar for all the varieties. On the contrary, the unsaturated fatty acids registered a significant decrease due to reduction in quality. Significant negative correlation between the saturated and unsaturated fatty acid contents indicates the proportional shifts in the ratio of the two kinds of acid during the quality changes in seeds.

By comparing the biochemical changes associated with seed deterioration it was established by this study that the chemical constituents of seed play a major role in its degree of deterioration.
A significant negative correlation between lipid peroxidation value and radical scavenging enzymes particularly in low vigour seeds is indicative of the accumulation of free radicals due to lower rate of their scavenging by the enzymes.

Among the antinutritional factors analysed, it was evident that phytic acid content as well as trypsin inhibitor decreased with decline in vigour, while the phenol content increased in the medium and low vigour lots of all the varieties. Since these factors registered a significant decrease even in the high vigour seed lots, it can be presumed that using short duration accelerated ageing or controlled ageing technique, the negative effects of antinutritional factors can be at least partially overcome, thus improving the nutritional quality.

A lowered mitotic index with fall in viability due to increased duration of ageing was observed in all the varieties tested.

The information of variability obtained among the varieties for seed longevity indicating genotypic differences, can be utilized by breeders in their crop improvement programmes for developing varieties with improved storability.

In the light of the aforesaid facts, it is concluded that seed deterioration and loss of viability may be due to marked changes in the biochemical content and activity of enzymes involved in degradation of stored reserves. In conclusion, we have shown that the decline in vigour of cowpea seeds under conditions of controlled ageing may be related to the decline of content of total carbohydrates and proteins, which are very essential for the keeping quality of the seed and provide the major nutrition for the growing embryonic axis when the seed is set to germination. It is also clear from the results that cowpea varieties differ in the rate of loss of viability and vigour for the same duration of ageing.

Thus it is clear from the present findings that seed ageing affected various physiological and biochemical processes essential to maintain seed viability and vigour. Results clearly indicate that controlled ageing test can be used as a successful technique in cowpea to obtain seed lots of different quality levels, which can be further used for various physiological, biochemical and cytological experimentation in search of reasons associated with loss in seed quality, which is a complex and intricate phenomenon.

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Summary and Conclusions