SUMMARY

SUMMARY

In short-term accelerated ageing (98.2% RH, 19±1°C) experiment for 21 days, leaching of sugar and amino acids from the seeds of gram (*Cicer arietinum*), soybean (*Glycine max*), sunflower (*Helianthus annuus*) and safflower (*Carthamus tinctorius*) cultivars steadily increased with the progress of ageing duration. Such deleterious changes were associated with proportional reduction in the levels of protein, RNA, insoluble carbohydrate and the activity of dehydrogenase enzyme in the seed kernels along with reduction in percentage TTC-stained seeds. In experiment with the same seed materials under long-term accelerated ageing (95% RH, 19±1°C) for 112 days, the above mentioned changes were drastic and all the seed samples were attacked by storage fungi of different species.

Pretreatment of the gram, soybean, sunflower and safflower seeds with Na-dikegulac (2,3:4-6-di-O-isopropylidene-α–L-xylo-2-hexalofuranosate) significantly arrested the leakage of soluble substances and checked the declining of the levels of some vital cellular components like carbohydrate, protein, RNA and dehydrogenase enzyme and also of the percent TTC-stained seeds. Accelerated ageing-induced damage in overall cellular metabolism and its substantial alleviation by Na-dikegulac have been conclusively proved from both the short-term and long-term accelerated ageing experiments of this investigation.

With the progress of accelerated ageing (95% RH, 19±1°C) from 10 to 40 days, the percentage germination of sunflower seeds gradually declined irrespective of the concentrations of Na-dikegulac as well as in distilled water control samples. However, this declining drift of seed germination was found to be much more pronounced in control set. All the concentrations of Na-dikegulac efficiently slowed down the fall of germination, and the effect was found much more significant at the later periods of observation.

Ageing-induced reduction of seed germinability was associated with parallel inhibition of field emergence of the sunflower seeds in both control and chemical pretreated seed samples. However, seed pretreatment with Na-dikegulac partially alleviated the ageing-induced impairment of field emergence.

Concomitant with the loss of seed germination and field emergence capacity as a result of accelerated ageing treatment, speed of germination was drastically slowed down in the control seed sample which underwent accelerated ageing treatment for 30 days. This is evident from less than 50% seed germination even after a germination period of 120 hours. On the other hand, speed of germination was found comparatively faster in the chemical pretreated seed lots under accelerated ageing condition. However, in the nonaged seed lots, the pretreating chemical was found to slow down the germination speed.

Changes of seed germination behaviour were associated with a proportional shift in seedling growth, measured in terms of root length, shoot length and dry weight of intact seedlings. Accelerated ageing treatment rendered a strong inhibitory effect on root length, shoot length as well as on seedling dry weight. Such inhibitory effect was found to overcome, at least partially, by seed pretreatment with Na-dikegulac prior to accelerated ageing treatment.

Metabolic status of the seeds was also altered as evident from the changes of some important macromolecules within seeds such as nucleic acids, soluble carbohydrates, amino acids, activities of dehydrogenase, amylase, catalase and protease enzymes. Both DNA and RNA levels in seed cotyledons were found to decrease with the advancement of ageing duration irrespective of control and the chemical-pretreated seed samples. However, the magnitude of reduction was much less in the chemical pretreated samples. On the other hand, soluble carbohydrate and amino acid levels progressively increased in seeds at least up to 30 days of seed ageing and such increasing trend was arrested by the pretreating chemical. Activities of dehydrogenase and catalase enzymes declined with seed ageing process throughout the ageing periods of observation both in control and in

chemical-pretreated seed samples. However, the rate of decreasing in activity was found to occur slowly in seeds which received pretreatemnt with Na-dikegulac. On the other hand, amylase and protease activities steadily increased as seeds age from 10 to 40 days. Na-dikegulac slowed down the rapid rate of increase of these two enzyme activities.

Plant growth and development was adversely affected when sunflower plants were raised from seeds which underwent accelerated ageing treatment (95% RH, 19±1°C) for 30 days. Ageing-induced inhibitory effect on plant height, stem circumferance, leaf area and dry matter content of intact plants continued at least up to head (capitulum) development stage (42-day-old) of sunflower plant. Seed pretreatment with Na-dikegulac at least partially relieved such ageing-induced inhibitory effect on growth performance as evident from comparatively higher values of the growth parameters recorded at seedling stage, preheading stage and head development stage of sunflower.

Accelerated ageing-induced hindrance on growth performance of sunflower plants in field was clearly reflected in plant metabolism as would be evident from the level of some vital cellular components in leaves viz., chlorophyll, protein, RNA and soluble carbohydrate as well as from the activities of catalase, superoxide dismutase, IAA-oxidase and protease enzymes. Significant reduction of chlorophyll, protein, RNA and soluble carbohydrate contents in leaves was recorded at all the three developmental stages (seedling, preheading and head development) of sunflower plants, developed from seeds which experienced accelerated ageing treatment for 30 days. The chemical-induced alleviation of such inhibitory effects on plant metabolism was evident from arrestation of the reduction of chlorophyll, protein, RNA as well as soluble carbohydrate levels. Concomitantly, the chemical efficiently reduced the ageing-induced loss in activities of catalase and superoxide dismutase enzymes as well as retarded the higher activities of the catabolic enzymes IAA-oxidase and protease in leaves.

Accelerated ageing treatment on sunflower seeds resulted in delayed growth and development of plants resulting in consequent lengthening of life cycle. Such delaying of

overall growth was clearly reflected in each and every stage of plant development analysed which include : radicle emergence, leaf emergence, head initiation, ray floret opening, 50% floret opening, 100% floret opening, head yellowing and harvest.

Changes of overall metabolic status of seeds, seedling growth, plant growth and plant metabolism were reflected in crop yield as evident from the analyses of some yield attributes like head diameter, total seed weight per plant, percentage filled seeds, 1000 seed weight as well as percentage seed oil. Accelerated ageing treatment on sunflower seeds resulted in poor field performance and subdued plant potential. Such subdued overall plant growth consequently caused impairment of crop yield as evident from the reduction of total seed yield per plant in conjunction with that of head diameter, filled seed percentage and 1000 seed weight.

Na-dikegulac also ameliorated the water stress-induced (imposed by PEG 6000) adverse effects on seed germination behaviour, seedling growth and metabolism in addition to accelerated ageing-induced deleterious effects on seed germination, seedling growth and metabolism. The pretreating chemical, irrespective of its concentrations, showed higher germination percentage in comparison to control seed lots when water deficit-stress was imposed for 48 hours on seeds which experienced or did not experience a previous accelerated ageing treatment for 30 days. Correspondingly, T50 hours were found to reduce in the chemical-pretreated seed samples indicating seed hardening property of the chemcial. Na-dikegulac –induced beneficial effect on germination behaviour under two stressful conditions, i.e. accelerated ageing and PEG-induced imposition of water deficit stress, was clearly reflected in seedling growth and metabolism. This was evident from comparatively higher seedling stature and increased dry matter content of intact seedlings as well as arrestation of loss of chlorophyll and protein levels and that of the activities of catalase and superoxide dismtase enzymes.

The beneficial effects of Na-dikegulac with respect to maintenance of higher storage potential of sunflower seeds, seedling performance, field performance of plants as well as tolerance capacity of seedlings against stressful situations are discussed.