

temperature and 100% relative humidity for 48, 96, 144 and 192 hrs and above observations were recorded. Statistical analysis was done as per the procedure given by Panse and Sukhatme [9].

RESULTS AND DISCUSSION

Pooled analysis of three years data for six seed quality parameters revealed significant differences due to storage periods and AA tests (Table 1). Mean initial germination at final count was 87%, which reduced to 74% after 6 months of storage period. Germination of same seed lots were 72% at 96 hrs of AA test, and were at par with the germination observed after 6 months storage period. It was very interesting to note that, the first count germination and field emergence of all seed lots were nearly equal at corresponding storage periods and AA tests. The pooled mean germination at first count over the years and storage periods was 67% and field emergence was 66%, which indicated close association between them.

All the four seed lots showed significant differences for germination due to different storage periods and AA tests during all the three years. Germination of all the seed lots falls below 50% of the initial level after 144 hrs of AA test. Germination percentage observed at 96 hrs of AA test in all the seed lots was not significantly different from germination status observed at 6 months storage period. Oxidative damages are responsible for the deterioration changes observed in aged seeds. Free radical oxidations, enzymatic dehydrogenation and aldehyde oxidation of proteins might reasonably contribute to the progress of seed quality [10].

Germination of seed deteriorated with progressive storage period [11]. Vigor tests provide additional information on the rate and uniformity of seedling growth and emergence ability under a wide range of environmental conditions [12, 13]. Both the vigour indices observed after 6 month storage period and 96 h of AA test were also non-significant. Electrical conductivity of seed recorded at beginning of storage was low, which may be attributed to integrity of cellular membrane of seed. It increased with progressive storage periods. The

rate of deterioration rapidly increases either with high seed moisture content or temperature of storage [14]. Decreased plasma membrane sustainability, changes in molecular structure of nucleic acid and decrease in enzyme activities resulted in lower germination potential with gradual increase in aging duration.

The evidence provided here indicates that deterioration treatment caused a remarkable decrease in germination characteristics. These results are in agreement with those of Ruzrokh *et al.* [15] and Verma *et al.* [16]. Failure of aged seeds to germinate might be due to lipid peroxidation, mitochondrial dysfunction and less ATP production. Mc Donald [17] and Ghassemi-Golezani *et al.* [10] reported that decrease in germination per cent and other indices can be related to physiological and biochemical changes during seed aging. Studies of Kapoor *et al.* [14] showed that accelerated aging in cowpea seeds affected all physiological parameters such as germination percentage and vigour index. Their findings also supported that decrease in seed viability, germination rate and vigour is correlated with biochemical changes (decreased soluble proteins and sugar content) associated with seed aging. Mean time to germination increased in deteriorated seeds in our study. It is in agreement with the results of Khaje Hoseini *et al.* [18]. They showed that deteriorated soybean seeds took longer time to germinate.

Correlation analysis of three years data of storage period and AAT (Table 2) showed significant and high positive correlation between 6 month storage period and 96 h of AA test (0.996), indicating strong association between them. Other characters also exhibited significant and positive correlation among themselves. However, germination after 144 h of AA test exhibited negative correlation with all other traits except 96 h of AA. Correlation analysis among the vigour parameters and field emergence (Table 3) showed significant and high correlation for first count with field emergence (0.957), followed by final germination count (0.951) and seedling dry weight vigour index (0.890). Various factors such as weather conditions during seed producing stage, pests and diseases, seed oil and moisture content, mechanical damages, storage time and

Table 3. Correlation matrix of vigour parameters and field emergence in soybean over three years

	First count germination (%)	Final count germination (%)	Vigour index (Seedling length)	Vigour index (Dry matter)	EC of seed leachate	Field emergence (%)
	1	2	3	4	5	6
1	—	0.996	0.867	0.826	- 0.618	0.957
2		—	0.849	0.816	- 0.634	0.951
3			—	0.847	- 0.537	0.858
4				—	0.641	0.890
5					—	- 0.680
6						—

$r = 0.532$

relative humidity of store can affect vigour of seeds [19, 20]. However, electrical conductivity of seed exhibited negative correlation with all the characters. Usberti [21] reported that the AA test after 12, 24, 48 and 96 h were significantly correlated with 2, 4, 6 and 8 month storage periods, respectively. The AA test at 96 hrs is an effective parameter for predicting storability of seed lots [22, 23]. Also the first count may be used as an effective indicator for field emergence, since it showed significant and high correlation.

CONCLUSION

From the present investigation it could be concluded that accelerated ageing test is an effective tool for predicting the storability and longevity of seed lots. The controlled deterioration and accelerated aging (AA) tests have been successfully used to rank and predict relative field emergence potential of seed lots in various crops

Germination status observed at 96 hrs of AA test could be considered as the status of germination after 6 months storage period in soybean. Among the different vigour parameters, first count germination, either singly or in combination with seedling dry weight is an important parameter for estimation of vigour and assessing the planting value of seed.

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