Anu Sheela Rai, Dhani Raj Chhetri and Aloke Bhattacharjee. (1995), *Seed Sci. & Technol.*, 23, 249–252

Research Note

Influence of sodium-dikegulac on storage potential of selected seed species

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(Accepted August 1994)

Summary

Accelerated ageing treatment (95% relative humidity, RH) for 112 days of seeds of some low-vigour species of gram, soybean, sunflower and safflower increased leaching of soluble carbohydrates and amino acids from all seed lots pretreated with 1000, 2000 and 4000 µg/ml sodium-dikegulac (Na-DK) or distilled water. However, some diminution of leaching was noted in the chemically pre-treated seed lots compared to the controls after 112 days of seed ageing. The ageing-induced reduction in the percentage of TTC-stained seeds and in total dehydrogenase activity was substantially ameliorated by Na-DK.

Experimental and discussion

Seed storage may influence seed viability and may also reduce seed vigour, depending on the storage conditions (temperature and humidity) and the length of storage period. The possibility of prolonging the vigour and viability of stored seeds by chemical manipulative techniques has been explored by a number of workers (Pathak and Basu, 1980; Bhattacharjee, Gupta and Purohit, 1986; Chhetri, Rai and Bhattacharjee, 1993). In the present investigation, we report the promising role of sodium-dikegulac (Na-DK) on the storage potential of a few low-vigour seed species.

After surface sterilization with 0.1% (w/v) $HgCl_2$ for 1.5 min, freshly harvested seeds of gram (*Cicer arietinum* L. cv. B-108), soybean (*Glycine max* L. cv. DS-73-16), sunflower (*Helianthus annuus* L. cv. Morden) and safflower (*Carthamus tinctorius* L. cv. JLA-900) were pre-soaked separately with aqueous solutions of Na-DK (1000, 2000 and 4000 µg/ml) or distilled water for 6 h and then dried back to their normal moisture levels of 6.4%, 6.7%, 6.0% and 5.8% respectively. At an interval of 48 h, such soaking/drying treatments were repeated three times to make the total duration of pre-treatment 18 h. The pre-treated seed lots (200 g each) were placed in separate cloth bags and stored in a desiccator, where an accelerated ageing environment (95% RH) had been pre-imposed with 250 ml H_2SO_4 (12.64%, v/v). The experimental set-up was kept at 19 ± 1 °C and the

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H_2SO_4 was replaced periodically to maintain the desired relative humidity (RH) within the desiccator.

Soluble carbohydrate (McCready, Guggloz, Silviera and Owens, 1950) and free amino acid (Moore and Stein, 1948) levels were analysed after immersing 1 g of the seed samples in 20 ml distilled water for 16 h. Tetrazolium chloride (TTC) stainability of seeds was determined following the method of Halder (1981) using 1% (w/v) TTC (2,3,5 – triphenyl tetrazolium chloride) solution. The activity of total dehydrogenases of intact seeds was analysed by the reaction of tetrazolium chloride, according to the method of Rudrapal and Basu (1979).

The data were statistically analysed at the treatment and replication levels, and least significant difference (LSD) values were calculated at 95% confidence limits (Panse and Sukhatme, 1967).

Leaching of soluble carbohydrates and amino acids from the seeds of gram, soybean, sunflower and safflower cultivars increased irrespective of treatment when data were recorded after 112 days of accelerated ageing (Table 1). However, this increase was significantly reduced in Na-DK pre-treated seed samples, regardless of the concentrations used. The percentage of TTC-stained seeds and the activity of total dehydrogenase enzymes declined sharply after 112 days of seed ageing, but the magnitude of the decline was less in all Na-DK pretreated seed lots (Table 2).

Leakage of soluble carbohydrates and amino acids (Table 1) from the seeds is indicative of possible damage to seed membranes. There are numerous reports that seed membranes are affected in deteriorating seeds (for example, Powell and Matthews, 1977; Francis and Coolbear, 1984) leading to a progressive loss of viability. Biochemical parameters are increasingly used as indicators of seed vigour and viability (Perl and Kretschemer, 1988). In this study, Na-DK substantially alleviated the loss of sugars and

Table 1. Effect of accelerated ageing and seed pretreatment with different concentrations of Na-DK on leaching of sobule carbohydrates (mg/g/20 ml) and free amino acids (mg/g/20 ml) from seeds of four species.

Parameters	Na-DK (µg/ml)	Gram		Soybean		Sunflower		Safflower	
		Days after accelerated ageing							
		0	112	0	112	0	112	0	112
Soluble carbohydrates	0	2.7	18.1	5.9	44.2	2.5	16.5	2.0	14.2
	1000	3.0	14.0	6.3	32.4	2.7	11.1	2.3	8.8
	2000	3.0	12.7	6.4	31.1	2.9	10.7	2.3	9.0
	4000	3.4	12.0	7.5	27.2	2.9	10.2	2.8	9.3
LSD (P = 0.05)		0.30	1.20	0.52	2.18	0.21	0.98	0.19	0.89
Amino acids	0	1.4	17.4	2.3	30.2	0.8	11.5	0.25	3.4
	1000	1.8	12.3	2.5	21.6	1.2	8.7	0.32	2.3
	2000	2.2	11.0	2.8	19.8	1.4	8.5	0.42	2.4
	4000	1.7	10.8	3.0	19.8	1.3	7.3	0.40	2.5
LSD (P = 0.05)		0.12	1.05	0.24	1.64	0.09	0.64	0.03	0.20

Table 2. Effect of accelerated ageing and seed pretreatment with different concentrations of Na-DK on the number of TTC-stained seeds (percent) and dehydrogenase activity (△ OD/g/ml) of the seeds of four species.

Parameters	Na-DK (µg/ml)	Gram		Soybean		Sunflower		Safflower	
		Days after accelerated ageing							
		0	112	0	112	0	112	0	112
Percent TTC-stained seeds	0	100	6.8	100	9.1	100	10.1	100	4.2
	1000	100	30.5	100	34.9	100	27.5	100	29.7
	2000	100	39.6	100	42.3	100	33.7	100	32.0
	4000	100	20.5	100	35.0	100	25.0	100	30.1
LSD (P = 0.05)		NC	1.05	NC	1.75	NC	1.60	NC	0.88
Dehydrogenase	0	0.72	0.22	0.66	0.19	0.53	0.14	0.55	0.17
	1000	0.68	0.35	0.67	0.32	0.55	0.27	0.55	0.32
	2000	0.68	0.40	0.65	0.40	0.55	0.33	0.53	0.31
	4000	0.70	0.38	0.65	0.31	0.53	0.28	0.52	0.30
LSD (P = 0.05)		NS	0.03	NS	0.02	NS	0.02	NS	0.03

NC = Not calculated
NS = Not significant

animo acids, and hence a role for this chemical in retaining membrane integrity, and thereby decreasing loss of seed viability, cannot be ruled out. However, loss of membrane integrity and its role in seed viability is still the subject of much debate. Solute leaching was associated with reduced TTC stainability and dehydrogenase activity of the artificially aged seeds (Table 2). A beneficial effect of Na-DK on the maintenance of seed viability can also be postulated from these two parameters, as the chemical was found to retard partially the rapid losses of percent TTC-stainability and enzyme activity. There are reports that as seeds age, they lose vigour as evaluated by counting percentage TTC-stained seeds and/or by observing the pattern of TTC staining (Halder, 1981). Again, dehydrogenase activity can be considered to be a reliable index for evaluation of seed viability (Abdul-Baki and Anderson, 1972). The present data thus indicate that in spite of accelerated ageing, Na-DK pre-treated seeds retained higher vigour than the controls.

Thus, from a number of viability indices using a range of crops it can be concluded that Na-DK may be used as a seed potentiating (or 'hardening') agent. Further work is in progress to establish its role in enhancing the storage potential of seeds.

Acknowledgements

The authors are grateful to Hill Affairs Branch Secretariat, Govt. of West Bengal for financial assistance in the form of a Research Project. The authors are also indebted to Dr. R. Maag Ltd., Dielsdorf, Switzerland for generous supply of Na-DK.

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