ot sorption of the en-complexes is attributed to their larger dimensions as dompared to that of the corresponding ammine complexes.

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CONTROL OF SEED DETERIORATION IN COTTON (*GOSSYPIUM HIRSUTUM* L.)

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ABSTRACT

The deterioration of cotton seeds under warm-humid conditions can be controlled by hydration–dehydration pretreatment of stored (5–6-month-old) seeds. A soaking duration of 2–3 hours for the fuzzy seeds and about one hour for the delinted seeds, followed by drying back to the original weight, would greatly reduce the loss of viability of seeds during subsequent storage. The treated seeds not only maintained a high germination percentage but also showed a significntly greater vigour of seedlings in comparison to the untreated control seeds. Although hydration itself gave the major effect, dilute solutions (2×10^{-4} M) of disodium phosphate and *p*-hydroxybenzoic acid showed further improvement in germination percentage of seeds.

INTRODUCTION

IN the major cotton belts of South India, cotton is grown in two seasons. But the seed of a particular harvest cannot be used immediately for sowing the following crop because of the time required for ginning and processing and for seed certification prior to marketing of seeds. Therefore the current seed has to be stored for 6-8 months after harvest. Further, many seed producers frequently have large surplus carry-over stocks which remain unsold and need to be stored till the next season. Under ordinary uncontrolled storage, cotton seeds lose vigour and viability at a fairly rapid rate. Temperature and humidity controlled storage facilities would greatly solve the problem of seed deterioration but at present very few growers and seed merchants have such facilities. Relatively inexpensive and easily practicable methods should therefore be standardised to maintain cotton seeds at a high level of germinability. Studies in this laboratory have led to the development of a hydration–dehydration method of seed treatment[1] for the stored seeds of a wide range of crop plants and in the present paper, the standardisation of seed treatment for controlling the deterioration of stored cotton seeds is described.

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MATERIALS AND METHODS

Two-month-old seeds of the popular cotton cultivar MCU5, obtained from the Cotton Breeding Station of the Tamil Nadu Agricultural University, Coimbatore, were stored in unsealed polyvinyl bags at 27° ± 5° C and a relative mean humidity of 73 ± 7% for three months. The 5-month-old fuzzy seeds were then given the hydration treatment by soaking in double the volume of distilled water for 0·5 to 5 hours. After soaking, the seeds were taken out and the excess water removed by blotting and dried back to the original weight in a current of hot air at 36° ± 1° C. The

control seeds were not hydrated but dried along with other treatments[1].

For hydrating the acid–delinted seeds, the following procedure was adopted. The fuzzy seeds were delinted using concentrated sulphuric acid at the rate of 100 ml/kg of seed, by constantly stirring the slurry for three minutes and then washing well with water three to four times[2]. The concentrated acid charred and solubilized the lint without affecting the seed. The delinted seeds were further hydrated in double the volume of distilled water at 25° ± 1° C for 0·5 to 5 hours. A portion of the delinted seed was not further hydrated but set apart and dried immediately which consistuted the control. The seed moisture content at different soaking intervals was estimated at 105° C for 16 hours[3].

The soaking treatment with chemicals was given to 6-month-old fuzzy and delinted seeds (seeds were delinted just prior to treatment) in double the volume of water or dilute solutions of sodium phosphate (dibasic, 2×10^{-4} M), *p*–hydroxybenzoic acid (2×10^{-4} M) and their combination in 1:1 proportion at the same concentration for two hours for fuzzy seeds and one hour for delinted seeds. After drying to a safe seed moisture content, the seeds were kept in desiccators over fused calcium chloride for one week for moisture equilibration in all the cases. Then the seeds were dry–dressed with Captan 75% WP (N–trichloromethyl–thio–4–cyclohexane–1, 2–dicarboximide) at 2g/kg of seed and stored in fresh cloth bags. Accelerated ageing treatment at 100% RH and 40° C, as attained by desiccators containing distilled water and placed in an incubator maintained at 40° C, was given for 6 and 5 days to fuzzy and delinted seeds, respectively.

Germination test was carried out in sand in plastic containers at room temperature. Thirty-three seeds were placed in each container after an initial soaking adopting uniform spacing and depth of sowing and three replications were provided. The germination tests were evaluated on the tenth day and the normal seedlings[3] alone were considered for percentage germination. Data on root length represent the mean total length of the primary root of ten representative normal seedlings from each replication. Dry matter content of the seedlings was recorded after drying all the seedlings in an hot air oven to a constant weight at 85° C.

Results and Discussion

The results obtained with hydration-dehydration treatments are given in Table I. The deterioration of cotton seed was very rapid under accelerated ageing treatment and a fall of nearly 50% in germinability was noticed in 5 to 6 days. The percentage of normal seedlings, which was over 82 in the original stocks, went down to 30 in artificially aged control seeds. The treatments significantly checked seed deterioration in fuzzy as well as in delinted seeds. Seeds hydrated for 1–3 hours gave better results than those hydrated for shorter or longer durations. Treatments given for 2 to 3 hours and 1 to 2 hours registered higher germination in fuzzy and delinted seeds, respectively. The root length and dry matter of seedlings were significantly more for seeds hydrated for 1 to 3 hours.

The beneficial effects of the treatments were dependent on the degree of seed hydration. The moisture content of the seed showed a sharp rise from the initial value of 9·0% to 36·0% in one hour in fuzzy seed and 10·6% to 33·1% in 30 minutes in the delinted seeds. Thereafter, water uptake continued at a slower rate upto 3 hours in the fuzzy and 2 hours in the delinted seeds. The final moisture contents after soaking for 5 hours were 43·0% and 43·6% for the fuzzy and delinted seeds, respectively.

The soaking–drying pretreatment given to 6-month-old stock seed with water or dilute solutions of chemicals checked seed deterioration under accelerated ageing condition as revealed by significantly higher germination, root length and dry matter production of seedlings both in fuzzy and delinted seeds (Table II). In comparison to the water effect, the chemical effects were of a minor nature, but even then substantial increases in germination percentage were obtained with both disodium phosphate and *p*–hydroxybenzoic acid. It was, however, of interest to note that the combination of the two chemicals did not show additive effects. On the other hand, a slight (statistically non-significant) retarding effect of the chemical combination was observed in germination percentage and vigour of seedlings.

The beneficial effect of the soaking–drying treatments on the maintenance of cotton seed viability confirm the earlier observations with seeds of other crops[4,5]. The possible mechanisms of action of the hydration–dehydration pretreatments have also been discussed in an earlier communication[1]. The effectiveness of hydration by moisture equilibration for 24–48 hours followed by dehydration in controlling the deterioration of cotton seeds would eliminate leaching of toxic products from the seed as a possible reason of the beneficial effect. The theory of germination advancement[6], which has been put forward to explain the beneficial effects of presowing seed treatments would not account for the present observations as only treatment of stored seed is effective. The concept of germination advancement would not explain

TABLE I

Effect of hydration-dehydration treatments on viability and vigour of 5-month-old cotton seeds (cv. MCU5) subjected to accelerated ageing[a]

Soaking duration (Hours)	Fuzzy seed			Delinted seed		
	Germination[b] %	Mean root length (mm)	Dry matter per seedling (mg)	Germination[b] (%)	Mean root length (mm)	Dry matter per seedling (mg)
0 (Control)	30 (33·2)	71	20	11 (19·4)	57	51
0·5	35 (36·3)	107	25	51 (45·6)	77	83
1	52 (46·2)	105	31	54 (47·3)	93	87
2	73 (58·7)	123	32	57 (49·0)	74	86
3	82 (64·9)	107	29	26 (30·7)	52	59
4	41 (39·8)	105	28	23 (28·7)	38	58
5	40 (39·2)	92	22	22 (28·0)	37	53
L.S.D. at 0·05 P	(6·9)	29	5	(10·1)	15	13
L.S.D. at 0·01 P	(8·5)	41	7	(14·2)	21	16

(*a*) Fuzzy seeds were aged for 6 days and delinted seeds 5 days at 100% RH and 40° C.

(*b*) Percentage of normal seedlings evaluated on tenth day; values in parentheses are the respective arc-sin transformations of the germination percentage data, the corresponding L.S.D. values (arc-sin) are also given in parentheses.

TABLE II

Effect of different physico-chemical treatments on the viability and vigour of 6-month-old cotton seeds (cv. MCU5) subjected to accelerated ageing

Treatments[a]	Fuzzy seed			Delinted seed		
	Germination (%)	Mean root length (mm)	Dry matter per seedling (mg)	Germination (%)	Mean root length (mm)	Dry matter per seedling (mg)
Control	6 (14·2)	74	62	23 (28·7)	54	26
Water	44 (41·6)	101	97	71 (57·4)	84	60
Sodium phosphate (dibasic)	50 (45·0)	106	104	75 (60·0)	91	61
p-Hydroxybenzoic acid	58 (49·6)	92	81	76 (60·7)	86	62
Sodium phosphate + *p*-Hydroxybenzoic acid	52 (46·2)	93	83	74 (59·3)	80	59
L.S.D. at 0·05 P	(10·7)	8	9	(8·4)	11	6
L.S.D. at 0·01 P	(15·5)	12	13	(12·2)	16	9

(*a*) Concentration of chemicals 2×10^{-4} M; other details same as in Table I.

the non-effectiveness of the treatments in harvest-fresh seeds. Whether the short-term hydration of less than an hour or so would cause significant restoration of age-induced damage, by activating the cellular repair system[7] is also doubtful because a longer period of hydration would be required for protein synthesis[8] and enzymatic repairs of cellular damage. It is believed that much of the ageing damage is caused by free radicals[9]. The quenching effect of hydration on the propagation of such free radicals may account for much of the beneficial effects of the soaking-drying treatments[1]. The chemicals like disodium phosphate and *p*-hydroxybenzoic acid would further add to the free radical quenching action of water. In fresh seeds, the endogenous radical level would be low and therefore the hydration-dehydration treatments would be ineffective.

The present observations clearly demonstrate a simple and easily practicable way of upgrading cotton seed quality. The treated seeds will maintain a high germinability over a longer period under ordinary storage. Many of the immature and damaged fuzzy seeds, which are otherwise difficult to separate, could be removed during the soaking treatment. The method of acid delinting of cotton offers complete surface sterilization[10] and facilitates the removal of immature, damaged and ill-filled seeds during the subsequent washing and hydration process. The well-filled heavier seeds sink in water and can therefore be readily separated from the rest. Our results show that merely by keeping the delinted seeds in water for an hour after washing away the acid would greatly reduce the subsequent deterioration of seeds. No additional expenditure is involved and there is absolutely no technical problem. It, however, remains to be seen whether the greater vigour of the treated seeds would also be reflected in the productivity of the crop as has been observed with other materials[11,12].

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ZOOLOGICAL SURVEY OF INDIA

WORKSHOP ON "TECHNIQUE IN PARASITOLOGY" HELD AT CALCUTTA ON JUNE 28 30, 1978

A three-day Workshop on "Techniques in Parasitology" organized by the Zoological Survey of India was inaugurated by Professor K. P. Sengupta, Director, Postgraduate Institute of Medical Education and Research and Surgeon-Superintendent, P. G. Hospital, Calcutta. More tran two dozen papers were discussed with reference to diverse aspects involved in *in vivo* and *in vitro* techniques of protozoans, helminths, insect parasites as well as their hosts. Collection techniques of diffrent vectors of disease were also emphasized as also the role of parasites as indicators of migration of hosts.

This is the third workshop being conducted by the Zoological Survey of India this year the earlier two being on 'Wild Life Ecology' at Dehra Dun and on 'Soil Micro-Anthropods' at Calcutta. The Zoological Survey of India has planned a National Symposium on 'Ecology of Animal Populations' from October 26th to 28th, 1978, at Calcutta.