was not reflected in the resulting hybrid, whereas the hybrid resulting from LRES 17 as one of the parents with other parents (i.e., LRES (7xRC (226) recording less yield exhibited substantial increase in yield with high percentage of heterosis. Such situation could be attributable to high inter-allelic interaction canceling the individual effects of each other.

The investigation reveals that the magnitude and nature of heterosis for yield and its components in the crosses were high over environments in the 10 hybrids. These hybrids may be utilized for commercial explotation of heterosis.

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SEED HARDENING TO AUGMENT THE PRODUCTIVITY OF COTTON cv.LRA 5166 (*Gossypium hirsutum* L.)

K. RATHINAVEL and C. DHARMALINGAM

Department of Seed Technology, Tamil Nadu Agricultural University
Coimbatore - 641 003.

ABSTRACT

Field experiments conducted in summer and winter 1996 seasons to assess the productivity of hardened seeds highlighted significant benefits of seed hardening with prosopis (*Prosopis juliflora*) (0.5% solution) and pungam leaf extract (*Pungamea pinnata*) (1.0%) registering increase in field emergence (9%), dry matter production (26.1 % on 30 DAS), plant height at harvest (23.2%) over control. The plants from hardened seeds came to flowering one week earlier than those from nonhardened seeds. The number of sympodia plant^{-1}, number of boll plant^{-1}, boll weight, seed weight boll^{-1}, number of seeds boll^{-1} were significantly higher in plants from seeds given seed hardening treatment with 1.0% pungam leaf extract striking an increase of 7.9, 35.2, 29.0 and 18.0% respectively over control in two seasons trials. The seed cotton yield and seed yield were higher by 31.7 and 35.7% respectively in the summer crop and 43.6 and 48.0 % respectively in the winter crop in the same treatment over control. In the resultant seeds better quality vested with the seeds from botanical hardening.

Cotton is an important fibre crop grown in India in about 76 lakh hectares, out of which 52 lakh hectares are under rainfed condition. The national average yield is 268 to 302 kg ha^{-1} as against the global average of 595 kg ha^{-1}. The low productivity in cotton is attributed to several reasons of which, use of poor quality seed for sowing forms the major one. Even good quality seeds may perform poor under adverse ecological conditions like moisture stress, high temperature. The present study, was made to explore the feasibility of using easily available botanicals for getting desired hardening effect to withstand drought during the early phase of germinaiton and seedling growth.

MATERIALS AND METHODS

A field experiment was conducted at the Agriculture College and Research Institute, Coimbatore during summer and winter of 1996. The experiment was laid out in black cotton soil with randomised block design using 20 m^2 plots in four replications.

Pre-cleaned cotton seeds of cv. LRA 5166 were soaked in solutions of potassium chloride 1.0% (T_1), 1.5% (T_2), 2.0% (T_3), pungam leaf extract (*Pumgamea pinnata*) 1.0% (T_4), 2.0% (T_5), 3.0% (T_6), prosopis leaf extract (*Prosopis juliflora*) 0.5% (T_7), 1.0% (T_8), 1.5% (T_9 for eight hours at ambient temperature by adopting 1:1 (v/v) seed to solution ratio. After soaking, the seeds were dried in shade, back to its original moisture content of 10%. Aqueous leaf extracts were prepared by macerating the fresh leaves in pestle and mortar and diluted to required concentration following filtering through Whatman No.1 filter paper. Seeds thus hardened were sown in dibbling method along with non hardened seeds (T0) at specified plant spacing. Plant protection and other cultural methods were followed as per the recommended package of practices. Biometric observations were taken in five plants marked randomly in each treatment replicationwise and the mean value expressed. After final picking seed cotton were pooled, weighed and expressed $plot^{-1}$.

RESULTS AND DISCUSSION

Pre-sowing seed treatments with chemicals, nutrient solutions, growth regulators and botanicals have been developed as a potential agro-technique to induce drought tolerance without impairing the germination potential of seeds. In cotton, effects of nutrient solutions for pre sowing treatment to improve germination and seedling growth were reported by Salwau *et al.* (1991) Ragah *et al.*, (1994) and Nirmala *et al.*, (1994). In the present study seeds hardened with prosopis leaf extract (1.0%) registered maximum field emergence during summer (Table 1) while in winter (Table 2) it was maximum in seeds hardened with pungam leaf extract (1.0%). However, the difference noticed between pungam and prosopis treated seeds were very marginal but were significantly better than the control and potassium chloride in both the seasons. The improvement in field emergence could be ascribed to activation of cells, which resulted in the enhancement of mitochondrial activity leading to the formulation of more high energy compounds and vital bio molecules which was made availbale during the early phase of germination (Dharmalalingam *et al.*, 1988).

The seedling dry matter production of plants studied 30 DAS and 60 DAS was high from seeds hardened with pungam leaf extract by 2.0 and 1.0% and prosopis leaf extract by 0.5 and 1.0%, respectively. Increased dry matter production due to hardening with chemical or growth regulators (KCl or CCC) wsa reported by Thandapani and Subharayalu (1986) in cotton. Jegathambal (1996) reported the beneficial effects of seed hardening with botanicals in sorghum.

Plant height increased by 20.5% at 60 DAS and 32.1% at harvest by the seeds hardened with pungam leaf extract (1.0%) followed in sequence by the seeds hardened with prosopis leaf extract across seasons (Table 1, 2). Hardening with potassium chloride did not show up improvement to that extent. This might be due to the early seedling vigour expressed through higher root and shoot length as well as increased dry matter accumulation. Cotton seeds hardened with succinic acid (Devolta and Chowdappan, 1977). Sodium salt or alpha phenyl butyric acid (Kariev, 1981) recorded higher plant height.

The number of days taken for initiation of flowering was less in the plants whose seeds hardened with pungam leaf extract (1.0%) in both seasons by 4.5 days. Vigorous plant growth accompanied by high dry matter accumulation enabled the plants to reach the grand growth period early and switch over to the reproductive phase much earlier than the plants in other treatments. Such physiological manifestations indeed are the resultant effects of seed vigour.

Yield components such as number of sympodia $plant^{-1}$, number of bolls $plant^{-1}$, boll weight, seed weight $boll^{-1}$, number of seed $boll^{-1}$ were all significantly higher in plants from hardened seeds with pungam leaf extract (1.0%) in both the seasons (Table 1, 2). Jegathambal (1996) in sorghum also reported increment of yield component traits such as earhead length and weight on account of

Table 1. Effect of seed hardening treatment on morphometric and reproductive characters of cotton cv. LRA 5166 during summer 1996

Parameter	Control (T0)	Potassium chloride 1.0% (T1)	Potassium chloride 1.5% (T2)	Potassium chloride 2.0% (T3)	Pungam leaf extract 1.0% (T4)	Pungam leaf extract 2.0% (T5)	Pungam leaf extract 3.0% (T6)	Prosopis leaf extract 0.5% (T7)	Prosopis leaf extract 1.0% (T8)	Prosopis leaf extract 1.5% (T9)	Mean	CD (P=0.05)
Field emergence (%)	82.0 (64.56)	89.0 (70.43)	88.0 (69.39)	86.0 (67.63)	88.0 (69.80)	88.0 (70.00)	86.0 (67.63)	87.0 (68.71)	92.0 (73.74)	90.0 (71.15)	87.0 (69.30)	2.47
DMP 60 DAS (g seeding^{-1})	6.10	7.00	9.75	6.15	9.10	6.10	10.95	7.50	8.10	7.70	7.85	1.01
Plant height 60 DAS (cm)	46.0	49.1	42.4	52.5	47.6	57.5	54.2	47.0	61.6	53.5	51.1	4.84
Plant height at harvest (cm)	63.4	72.2	67.8	74.9	78.5	73.6	67.4	75.6	76.2	77.0	72.7	3.85
Date of first flowering	67.0	69.0	65.0	72.0	63.0	65.0	67.0	70.0	71.0	71.0	68.0	2.28
Number of sympodia plant^{1}	19.0	18.0	17.0	16.0	22.0	16.0	15.0	14.0	16.0	14.0	17.0	1.81
Number of bolls plant^{-1}	27.0	27.0	27.0	28.0	35.0	28.0	26.0	27.0	31.0	31.0	29.0	2.17
Boll weight (g)	3.38	3.13	3.39	3.05	3.73	3.05	2.83	2.95	3.39	3.03	3.19	0.50
Seed weight (g boll^{-1})	1.50	1.13	1.13	1.33	1.83	1.74	1.28	1.43	1.53	1.23	1.41	0.29
Number of seeds boll^{-1}	25.0	25.0	22.0	19.0	29.0	23.0	22.0	21.0	28.0	26.0	24.0	2.53
Seed Cotton yield plot^{-1}-20m^{2}	2.71	3.02	3.24	3.11	3.57	3.39	3.20	2.96	3.26	3.33	3.18	0.41
Seed yield plot^{-1}-20m^{2}	1.68	1.88	2.09	1.99	2.28	2.17	1.98	1.84	2.09	2.13	2.01	0.24
100 seed weight (g)	7.405	7.917	7.754	7.640	8.113	7.912	7.190	7.290	7.143	7.269	7.564	0.447

(Figures within parenthesis are arcsine transformed values)

hardening with botanicals such as pungam and prosopis.

Seed cotton weight and seed weight were higher for plants from seeds hardened with pungam leaf extract (1.0%). The leaf extract used for hardening had improved the root system significantly which enabled the plants to derive the available soil moisture and nutrients from the soil more efficiently resulting in better plant growth, higher seed cotton weight and seed yield. The yield component characters were enhanced significantly which evidently explain for the yield improvement. The increased seed yield was also noticed by Umarova and Urmanov (1978) in cotton when seeds were soaked in *Nostoc muscorum* suspension. In sorghum Jegathambal (1996) reported similar result when seeds were hardened with prosopis + pungam (each 1.0%) leaf extracts.

Table 2. Effect of seed hardening treatment on morphometric and reproductive characters of cotton cv. LRA 5166 during winter 1996

		Potassium chloride			Pungam leaf extract			Prosopis leaf extract				
Parameter	Control (T0)	1.0% (T1)	1.5% (T2)	2.0% (T3)	1.0% (T4)	2.0% (T5)	3.0% (T6)	0.5% (T7)	1.0% (T8)	1.5% (T9)	Mean	CD (P=0.05)
Field emergence (%)	83.0 (65.85)	84.0 (66.07)	82.0 (64.55)	79.0 (62.41)	91.0 (72.08)	87.0 (68.66)	83.0 (65.28)	83.0 (65.85)	88.0 (69.55)	85.0 (67.24)	84.0 (66.75)	2.51
DMP 60 DAS (g seeding⁻¹)	9.45	9.95	8.95	7.15	10.40	10.00	10.20	10.20	10.45	9.55	9.63	0.51
Plant height 60 DAS (cm)	74.1	73.7	76.0	76.7	89.3	76.7	74.7	73.1	80.5	77.2	77.2	5.30
Plant height at harvest (cm)	78.6	77.7	82.6	80.6	96.4	90.4	91.2	82.1	96.3	87.0	86.3	4.64
Date of first flowering	66.0	65.0	64.0	71.0	61.0	64.0	68.0	68.0	65.0	65.0	66.0	1.76
Number of sympodia plant⁻¹	22.0	22.0	22.0	20.0	24.0	23.0	21.0	23.0	24.0	21.0	22.0	NS
Number of bolls plant⁻¹	27.0	28.0	31.0	30.0	38.0	31.0	31.0	34.0	33.0	33.0	32.0	3.31
Boll weight (g)	3.28	3.41	3.31	3.46	3.80	3.67	3.73	3.48	3.70	3.57	3.54	0.34
Seed weight (g boll⁻¹)	2.03	2.15	2.07	2.27	2.76	2.39	2.32	2.40	2.39	2.31	2.31	0.33
Number of seeds boll⁻¹	25.0	26.0	24.0	25.0	30.0	25.0	26.0	26.0	29.0	27.0	26.0	2.93
Seed Cotton yield plot⁻¹-20m²	3.19	3.68	3.65	3.64	4.58	4.03	4.10	3.90	4.50	3.86	3.91	0.73
Seed yield plot⁻¹-20m²	1.98	2.98	2.26	2.35	2.93	2.58	2.62	2.50	2.88	2.47	2.48	0.46
100 seed weight (g)	8.547	8.887	8.812	8.381	8.855	8.197	8.644	8.388	8.656	8.571	8.594	NS

(Figures within parenthesis are arcsine transformed values)

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SOIL TEST CROP RESPONSE STUDIES FOR RAINFED SORGHUM

G. SELVAKUMARI, R. SANTHI, P. MURUGESA BOOPATHI and K.K. MATHAN

Department of Soil Science and Agricultural Chemistry
Tamil Nadu Agricultural University
Coimbatore - 641 003.

ABSTRACT

Field experiments were conducted in Vertic Ustochrept to find out the feasibility of adoption of soil test based fertiliser recommendations for rainfed sorghum. Fifty per cent of NPK fertilisers recommended for irrigated sorghum, as per targeted yield and Mitscherlich-Bray concept were applied to rainfed sorghum and these two methods were compared with blanket recommendation. Results showed that targeted yield approach recorded higher yield, response yardstick and benefit cost ratio than Mitscherlich-Bray and blanket recommendations. Hence, for better fertiliser use efficiency, yield and profit, 50 per cent of NPK prescribed for any desired yield targets of irrigated sorghum could be recommended for rainfed crop, in the mixed black soils of Western Zone of Tamil Nadu.

KEY WORDS: Soil test based fertiliser doses, response yardstick, Benefit Cost Ratio

Coarse grain and pulse crops are grown mostly as rainfed crops. Among the several factors that cause low yields of rainfed crops, inadequate application of fertilisers to dryland crops is a major one (Tandon, 1993). The blanket recommendation of rainfed millets is 40 and 20 kg ha^{-1} of N and P_2o_5 respectively. However, while augmenting the nutrient supply of any crop through fertilisers due allowance must be given to the nutrients that are supplied through native soil source. A soil test usually gives the relative amount of the available nutrient present in the soil. For the most economic rates of fertilisers for the crops to be grown in any type of soil, the soil tests could be interpreted in terms of the expected crop response to added fertilisers. The modified Mitscherlich-Bray (Bray, 1954) and Targeted Yield (Ramamoorthy *et al.*, 1969) approaches are the basis for arriving at such soil test based fertiliser doses. An attempt was made in the present investigation, to find out the feasibility of adoption of such approaches to recommend fertiliser doses for rainfed sorghum.

MATERIALS AND METHODS

Field experiments were conducted during *Kharif* 1992 and 1993 in mixed black soil (Vertic Ustochrept) at Tamil Nadu Agricultural University Farm in Coimbatore. The initial soil samples were analysed and it was found to contain 280 kg of alkaline $KMnO_4$-N (Subbiah and Asija, 1956), 10 kg of Olsen-P (Olsen *et al*, 1954) and 400 kg of NH_4 OAc-K (Standford and English, 1949) per hectare. The pH was 8.2 and E.C. was 0.2 dSm^{-1}. The test crop was sorghum var. CO 26. There were five treatments replicated four times in randomised block design. The treatments were (i) control, (ii) blanket recommendation, (iii) 50 per cent of NPK recommended for irrigated sorghum by soil testing laboratory based on modified Mitscherlich-Bray concept, (iv) fifty per cent of NPK recommended