Fatty Acid Application to Germinating Cottonseed

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In last year's cotton report, we indicated an increasing trend in cottonseed germination under chill stress after seed treatment with unsaturated fatty acids. We tried this procedure under field conditions. The tabulation for fatty acid pretreatment at 3 locations are shown in Table I. No trends can be seen in all three locations due to the lack of significant cold stress during the period of experimentation. The second phase was to reconfirm some preliminary experiments performed last year wherein pretreated seeds were observed for radicle elongation and germination under controlled stress conditions in the laboratory.

There were several additional questions, however, that needed to be resolved. First, would safflower oil, a vastly cheaper source of unsaturated oil ($.30 to $.50 vs. $.75 to $1.00 per acre treatment) be as effective as the pure unsaturated oil to enhance germination under chill stress temperatures. Secondly, the original procedure of applying the oil to the seed involved an imbibing process just prior to planting. Since this procedure is cumbersome and not practical under normal planting conditions, tests were undertaken to determine the effect of drying the seed down to normal size at room temperature and storing for several days before planting.

PROCEDURE: Lots of Pima S-5 seed were allowed to imbibe a mixture of unsaturated fatty acid and 5% Dimethyl sulfoxide (DMSO) in water for several hours. After the seeds were fully imbibed, they were either planted right away or allowed to dry to normal seed size for a period of 4 to 5 days before planting. The controls were water imbibed and 5% DMSO imbibed seed. The seeds were planted and grown for seven days at 18^{o}C in standard germination paper placed in a high humidity growth chamber. The seeds were not exposed to light at this time. Germination counts were made at the end of this time in which all seed with radicles less than 10mm were excluded from the germination count.

RESULTS: Safflower oil was taken at the same level of linoleic acid as in Tables II and III. There was a statistical difference between oil treated seed and water treated controls. In both treatments there is approximately a 35% increase over the water control but no increase over the 5% DMSO control. Thus, although safflower oil is just as effective as the pure linoleic acid in producing a response of increased germination under chill stress, the interesting feature of this data is that the carrier solvent alone is just as effective as the oil imbibed into the seed.

The next logical phase of this investigation was to examine the effect of the solvent at different concentrations. In addition, we wanted to note the effect of seed drying before planting.

Table IV shows that for several representative runs, there is an 18 to 20% increase of germination over the water control on the average. Note that the effect is essentially the same for both the 5 and 10% concentrations. Any concentrations over 10% lowered germination even at normal temperatures. We then examined the effect of drying and storing the carrier solvent treated and water control seeds for several days before planting. Again, there was an increase over the dried control seeds by 21% (Table V). Although longer periods of drying time were not examined, it was presumed that the effect would be the same since much of the drying took place over four days at room temperature.

Thus the data clearly indicates that the carrier solvent itself is as effective as the purified unsaturated oil carried into the seed. As a result of this observation, we tried an array of organic solvents (9 in all) that were completely miscible with water. DMSO was the only one to exhibit the effects noted above. This solvent has been reported by other workers to be a membrane stabilizer at low chill temperatures due to its aprotic dipolar nature.

TABLE I.

Effect of fatty acid pretreatment (Linoleic and Linolenic) on Pima S-5 % field emergence.

LOCATION	CONTROL	DMSO	18:2	18:3
Phoenix	43.9	43.5	46.4	43.6%
Safford	46.6	37.3	34.5	32.3%
Marana	12.9	17.9	15.8	12.9%

TABLE II.

Effect of linoleic acid pretreatment on Pima S-5 % germination at 64.4 F

0	DMSO	45	90	180	360 ppm
54.0b	70.0a	74.0a*	72.0a	68.0a	76.0a%

*P<0.05

TABLE III. Effect of H_2O, DMSO and Safflower Oil

	CONTROL	H_2O	5% DMSO	180 PPM OIL 5% DMSO
Set #1	17	21	45	38
2	22	25	29	32
3	28	30	37	42
4	29	29	40	32
5	16	25	37	32
Average	22.4	26.0	37.6	35.2

TABLE IV. Effect of DMSO on Pima S-5 % growth chamber emergence

Planted wet, immediately after treatment

	CONTROL	5% DMSO	10% DMSO
Set #1	62	67	73
Set #2	51	58	63
Average	57	63	68

TABLE V.

Planted dry, four days after treatment

	CONTROL	5% DMSO	10% DMSO
Set #3	36	50	64
#4	53	58	52
#5	48	61	56
Average	46	56	57