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Seed Treatment against Black Arm Disease of Cotton

by

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Introduction: Black arm or angular leaf spot or bacterial blight of cotton caused by *Xanthomonas malvacearum* (Smith) Dowson, has been prevalent in the Madras State for over thirty years (Ramakrishnan 1950). Primary infection is mainly through the seeds. Rain combined with heavy winds (rainstorms) helps in the spread of the disease (Andrews 1936, Brown 1941). Control of primary infection of black arm by seed treatment has been attempted in several countries with varying degrees of success. Seed disinfection with formalin (1 : 100) has been found to be very effective in theU.S.S.R. (Verderevski 1937). Ceresan materially increased the seedling emergence and yield of cotton in various localities in Texas, at the same time reducing the incidence of angular leaf spot (Smith et al 1936). Massey (1937) has found that the use of mercurial dusts like Abavit B, ethyl mercury phosphate, ethyl mercury iodide, phenyl mercury acetate and several others gave satisfactory control of black arm in Africa. Seed treatment with mercuric iodide had resulted in the control of black arm in the Sudan (Clouston and Andrews 1938). Macdonald et al (1947) have stated that delinting with sulphuric acid and the removal of floaters have resulted not only in the reduction of primary infection of black arm but also improved the germination and vigour of the seedlings. Ramakrishnan (1950) used formalin as steep and dust, Ceresan and Agrosan GN as seed dressings and observed that all these gave protection from primary infection. Tarr (1953 a, b, c) after the use of several seed dressing agents found that mercuric iodide gave better protection as a steep than as a dry dressing. Tarr has further observed that slurry methods were most effective when applied to acid delinted seeds and that soluble organomercury compounds were preferable for slurry methods. Acid delinted seeds were much more susceptible to mercury injury than fuzzy ones. Cuprous oxide was also found to be a promising seed dressing for the control of black arm. (Tarr 1953 a).

Several seed dressings are being put on the market from time to time and in order to test their relative efficacy in comparison with organo-mercurials like Agrosan, Ceresan etc., a series of experiments were conducted both in the field and under greenhouse conditions. A brief outline of the results obtained in these experimentsis presented in this paper.

Materials and Methods: Seeds of MCU 1. cotton, were artificially inoculated with the pathogen by soaking the seeds in a suspension of bacteria for one hour and drying in the shade. They were then treated with various seed dressings for fifteen minutes at 1 : 150 by weight. Care was taken to ensure a thorough mixing of the fungicide with the seed so as to obtain a uniform coating of the substance on the surface of the seed. Delinting was done by using concentrated sulphuric acid at the

rate of 1 lb. of acid for 12 lb. of seed. The requisite amount of sulphuric acid was added little by little to the seeds kept in a mud or procelain container constantly stirring the seeds for about 15 minutes. These seeds were washed free of sulphuric acid in three changes of cold water and dried in the sun. The floating seeds were removed while washing and tested separately. In the case of the pot experiments the number of replications varied from 3 to 5 and in each replication (seedling pan) 30 to 50 seeds were sown. Records of germination and percentage of primary infection were maintained. In addition, the vigour of the seedlings was assessed by recording their linear growth. The results were subjected to statistical analysis. Experiments were conducted under both greenhouse and field conditions.

Observation: In one series Agrosan GN, Fernasan, Y.F. 2776 and Perenox were used. The percentage of germination and primary infection in this experiment are given below:

TABLE I
Percentage of germination and primary infection

Treatment	Percentage of germination	Percentage of primary infection
Agrosan GN	82	12·2
Fernasan	69	24·6
Y. F. 2776	70	55·7
Perenox	73	61·6
Control	75	68·6

From the above it is evident that Agrosan GN and Fernasan have effectively reduced primary infection. Further, Agrosan GN has given a higher percentage of germination over control. The other fungicides were found to be more or less on a par with the control. It has been reported from Africa (Annual Rept. of the Emp. Cott. Gr. Corpn. 1952) that copper compounds not only reduced the primary infection but also increased vigour, yield etc. But from the above experiment it is clear that the copper fungicide Perenox does not afford sufficient protection against primary infection and is only on a par with the control under greenhouse conditions.

In order to confirm the findings with regard to germination and vigour, other experiments were conducted in pots using Agrosan GN and Perenox. The seeds after treatment were sown in pots

TABLE II

Germination Percentage in the Various Treatments on the 8th Day After Sowing

(Lay out—Split-plot Design)

Dates of Sowing		25th May 1953				10th June 1953				30th July 1953			
Main treatments	Sub treatments	Agro-san GN	Pere-nox	Con-trol	Mean	Agro-san GN	Pere-nox	Con-trol	Mean	Agro-san GN	Pere-nox	Con-trol	Mean
		(a)	(b)	(c)		(a)	(b)	(c)		(a)	(b)	(c)	
A. Acid-delinted seeds—SINKERS ..		82·50	76·50	90·00	83·34	90·00	92·66	95·34	89·34	90·63	96·30	96·30	94·38
B. Acid-delinted seeds—FLOATERS ..		51·00	44·50	41·50	45·66	64·00	47·34	49·34	43·56	62·50	66·25	71·25	66·68
C. Acid delinted seeds without removing floaters ..		69·50	71·50	66·50	69·16	72·66	56·00	61·34	63·34	80·00	85·63	81·25	82·30
D. Fuzzy seeds (Control)..		67·00	74·50	65·50	72·34	74·66	61·34	66·00	67·34	89·53	88·75	85·00	87·70
E. Fuzzy seeds treated with cowdung ..		—	Not included		—	—	Not included		—	82·50	71·25	76·25	76·65
F. Fuzzy seeds treated with red earth ..		—	Not included		—	—	Not included		—	80·63	79·38	73·13	77·73
Mean ..		70·00	66·76	66·12	—	75·33	61·84	68·00	—	81·78	81·25	80·52	—
Main treatments—Conclusions		Significant—C. D. = 6·60 A, D, C, B				Signicant—C. D. = 14·0 A, D, C, B				Significant—C. D. = 10·88 A, D, C, F, E, B			
Sub treatments—Conclusion		Not significant				Significant C. D. = 6·80 a c b				Not significant			

TABLE III

Mean Length of Seedlings in Centimeters on the 8th Day After Sowing
(Lay out—Split plot design)

Date of sowing		25th May 1953				10th June 1953				30th July 1953			
Main treatments	Sub treatments	Agro-san GN	Pere-nox	Con-trol	Mean	Agro-san GN	Pere-nox	Con-trol	Mean	Agro-san GN	Pere-nox	Con-trol	Mean
		(a)	(b)	(c)		(a)	(b)	(c)		(a)	(b)	(c)	
A. Acid-delinted seeds SINKERS ..		7·95	6·45	7·37	7·26	6·43	7·07	8·20	7·23	6·65	6·28	6·08	6·34
B. Acid-delinted seeds FLOATERS ..		6·80	6·14	5·47	6·14	7·47	6·23	5·70	6·47	5·50	4·80	5·08	5·13
C. Acid-delinted seeds without removal of floaters ..		7·41	6·05	6·20	6·55	6·33	5·13	6·17	5·88	5·73	5·23	5·75	5·57
D. Fuzzy seeds (Control)..		7·95	7·04	6·14	7·04	7·73	5·87	6·13	6·58	6·75	5·78	5·73	6·08
E. Fuzzy seeds treated with cowdung ..		—	Not included		—	—	Not included		—	6·55	5·50	5·25	5·77
F. Fuzzy seeds treated with red earth ..		—	Not included		—	—	Not included		—	5·85	5·55	5·75	5·72
Mean ..		7·53	6·42	6·29	—	6·99	6·08	6·55	—	6·78	5·52	5·60	—

Main treatments—Conclusions	Significant C.D. = 0·62	Significant—C.D. = 0·77	Significant C.D. = 0·53
	A, D, C, B	A, D, B, C	A, D, E, F, C, B
Sub treatments—Conclusions	Significant, C.D. = 0·66	Significant—C.D. = 0·58	Significant C.D. = 0·34
	a, b, c	a, c, b	a, c, b

containing washed sand. The seedlings were removed on the eighth day after sowing, their number counted and length measured. Here also, acid delinted and fuzzy seeds were utilised. The data on germination percentage and length of seedlings are given in tables II and III respectively.

It is clear from these tables that acid delinted sinkers always gave the maximum percentage of germination. Among the seed dressings Agrosan GN treated seeds gave the highest germination percentage and in one experiment this treatment was significantly superior to Perenox and control while Perenox treated seeds sometimes even produced lesser number of seedlings than the control. As regards the length of seedlings again, acid delinted sinkers produced the tallest seedlings. These findings are in keeping with the observation of Macdonald et al (1947). Among the seed dressings, Agrosan GN again gave significantly taller seedlings in two experiments, thereby indicating that Agrosan GN not only gave protection from primary infection but also induced the germination and vigour of the seedlings.

It is the general practice with ryots to treat cotton seeds with cowdung or red earth and dry them prior to sowing to facilitate easy separation of the seeds while sowing. In order to test the effect of these treatments, an experiment was conducted with graded doses of cowdung and red earth made into a paste with the minimum quantity of water required for thorough mixing with the cotton seed and sun-dried before sowing. The percentages of germination are given in table IV.

TABLE IV

Treatments	Germination percentage
Cowdung : Cotton seed 1 : 3 by weight	56·4
do. do. 1 : 6 do.	75·2
do. do. 1 : 12 do.	30·4
do. do. 1 : 24 do.	01·6
Red earth : Cotton seed 1 : 3 do.	37·6
do. do. 1 : 6 do.	39·2
do. do. 1 : 12 do.	30·0
do. do. 1 : 24 do.	83·2
Cotton seed treated with mere water	95·2
Control (Untreated) MCU 1 seed	94·8
CD = 16·79	

It is seen from the above data that cow dung at strengths 1 : 12 and below and red earth at 1 : 24 did not affect the germination

capacity, while higher proportions impaired the germination to a marked extent.

In another experiment combinations of Agrosan GN with red earth and cow dung were used for treating the seed. The results are given in table V. Only fuzzy seeds were used in this experiment.

TABLE V
Percentage of germination and primary infection

Treatments		Germination	Primary infection
1. Agrosan GN 1 : 150	..	87	3·4
2. Agrosan GN 1 : 300	..	86	1·2
3. Agrosan GN + red earth	..	83	6·0
4. Agrosan GN + cowdung	..	74	6·8
5. Red earth + Agrosan GN	..	85	9·4
6. Cowdung + Agrosan GN	..	75	4·0
7. Cowdung alone	..	83	10·8
8. Red earth alone	..	87	11·5
9. Fuzzy control	..	82	9·8

In treatments 3 and 4 the seeds were first treated with Agrosan GN and then with cowdung or red earth. In treatments 5 and 6 the seeds were treated first with cowdung or red earth and then with Agrosan GN. It is seen from the above that treatment with cowdung and red earth alone have not reduced primary infection while Agrosan GN has reduced the infection.

Field experiments were also conducted in 1952-53 season using Agrosan GN. Fernasan, Tritisan and Y. F. 2776 as seed dressings. Artificially infected MCU 1 fuzzy seeds were used for the experiment. The percentage of primary infection in the various treatments were recorded and are tabulated below:

TABLE VI
Percentage of primary infections in the various treatments

Treatment	% Primary infection
1. Agrosan GN	15·25
2. Tritisan	38·75
3. Y. F. 2776	18·13
4. Fernasan	5·13
5. Control	36·63
CD = 14·84	

The results were found to be statistically significant. Fernasan, Agrosan GN, and Y. F. 2776 were superior to control in reducing primary infection.

Conclusions: From the results of the foregoing experiments it is clear that indiscriminately heavy doses of cowdung and red earth have an adverse effect on the germination capacity of the cotton seeds and as such have to be avoided. Red earth at the strength of 1 : 24 and cow dung at 1 : 12 and below did not have an adverse effect on germination. The advantages of using acid-delinted sinkers

instead of cowdung or red earth treated seeds are:— (i) the former ensures more uniform, quicker and higher germination with better vigour of seedlings, besides facilitating easy separation of the seeds, and (ii) the cost of treatment with sulphuric acid works out only to Re. 1/- per acre and this is a negligible sum when compared to the benefits accruing from the treatment. In places where acid-delinting is found difficult, seed treatment with Agrosan GN will be of much use, as the latter also increases the germination capacity of the seed as well as the vigour of seedlings besides reducing seed-borne infection of black arm.

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