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# FIELD MOLD CONTROL *with Arasan 42-S*

*to Improve the Appearance and Quality of Sorghum Seed*



THE AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
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## Summary


Field mold development was reduced in white kafir seed treated with Arasan 42-S at rates of 1 gallon per acre and applied during the milk growth stage at Prairie View in 1958. White kafir seed also were protected from field mold with treatments of 1¼ and ¾ gallons of Arasan 42-S per acre at College Station in 1959.

The reduction in field mold development at both locations resulted in natural, bright-colored seed.

The percentage germination of treated and untreated seed was essentially the same in the 1958 test. Seed subjected to the cold soil test after 1 year in storage revealed no difference among the treatments in the percentage of emerged seedlings.

A higher percentage of seedling emergence was obtained in the cold soil test from seed treated with rates of 1¼ and ¾ gallons of Arasan 42-S per acre applied in 1959. When Arasan 42-S was removed before testing in cold soil, a higher seedling emergence percentage still was obtained from seed which had received previous field treatments of 1¼ gallons of Arasan 42-S per acre. The higher seedling emergence was attributed to improved seed quality protected with field applications of Arasan 42-S.

Laboratory weathering of field-treated and nontreated sorghum seed harvested in 1958 and 1959 deteriorated at about the same rate. Field-treated seed receiving additional Arasan 42-S after harvest were more resistant to seed deterioration. The amounts of Arasan 42-S remaining on the seed from field application were not sufficient to resist deterioration in the laboratory.

# Field Mold Control with Arasan 42-S to Improve the Appearance and Quality of Sorghum Seed

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DISCOLORATION OF SORGHUM SEED by field mold is prevalent in areas of high relataive humidity and intermittent rainfall during the sorghum maturation period. The severity of mold infestation varies each year according to weather conditions, but may be present to some degree each year in the more humid areas. Since the degree of field mold growth is associated closely with weather conditions, seed discoloration in the field often is called "weathering."

Christensen (1957) states that such species as *Alternaria, Helminthosporium* and *Cladosporium* have dark mycelia that invade the pericarp (seedcoat) during humid weather. These species are the most common molds associated with seed discoloration. Field mold species such as *Fusarium* may contribute to seed deterioration in storage.

Bright seed having little or no mold development may be produced in regions with relative low humidity during the sorghum maturation period. Sorghum seed produced in the western states often are marketed for premium prices due primarily to the farmers' and seedsmen's demand for bright seed. Texas seedsmen frequently have a problem in producing mold-free hybrid sorghum seed. This study was made to determine whether fungicides could be used in hybrid sorghum crossing blocks to produce mold-free seed and the possible advantages of this seed over that produced under natural conditions without chemical treatment.

## Methods

### *Field Treatments at Prairie View, 1958*

Heads of the white seeded sorghum variety, Combine Kafir-60, were treated during the milk and hard dough growth stages with rates of 1, ½ and ¼ gallons of Arasan 42-S per acre. Arasan 42-S is a liquid suspension of 42 percent Thiram which adheres to plant materials. The spray was applied by a cone-type nozzle located 4 to 5 inches above the sorghum heads. To insure adequate coverage, sufficient water was added to the Arasan 42-S for a total spray volume of 10 gallons per acre. Each treatment was applied on 2 rows, 50 feet long in each of 4 replications.

### *Field Treatments at College Station, 1959*

Rates of 1¼ and ¾ gallons of Arasan 42-S per acre were applied during the milk and hard dough growth stages. Each treatment consisted of 2 rows, 20 feet long and was replicated twice at both growth stages. Since small plots were involved in this experiment, a hand sprayer calculated to spray 30 gallons per acre (Arasan 42-S + water) was used to insure adequate coverage.

### *Determination of Seed Viability*

A composite sample of seed was harvested from each row receiving the various treatment rates in 1958 and 1959. Seed from each sample were germinated according to the rules and regulations of the Association of Official Seed Analyst (1954). The reserve seed harvested in 1958 were stored 1 year and then regerminated.

To further evaluate Arasan 42-S treatment in the field, a cold soil germination test was conducted to determine seedling vigor and resistance to soil fungi. The method outlined by Isely (1955-57) for cold testing corn was followed. Four replications of 50 seed from each treatment were planted in unsterilized soil held in plastic containers. The plastic containers were placed in cold chambers for 7 days at 50° F. and then removed to more optimun conditions for 3 additional days. The percentage of emerged seedlings were determined at the end of 10 days.

To determine the extent of resistance to deterioration, field-treated seed were subjected to a laboratory method employed by Bird (1957) for simulating weathering in the field. Fifty grams of each sorghum sample were placed in half-pint jars with a 50 cc., container of water. A filter paper wick was inserted into each water contained to insure high humidity within each jar. The jars containing the seed and water con-

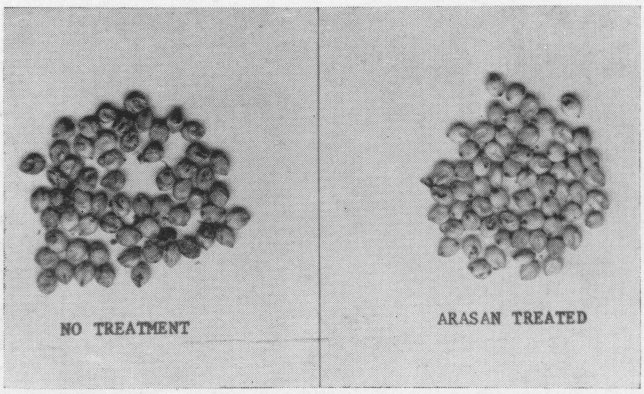


**Figure 1. Arasan 42-S treated and nontreated sorghum seed. Note the discolored seed caused by field mold development on the left (nontreated).**

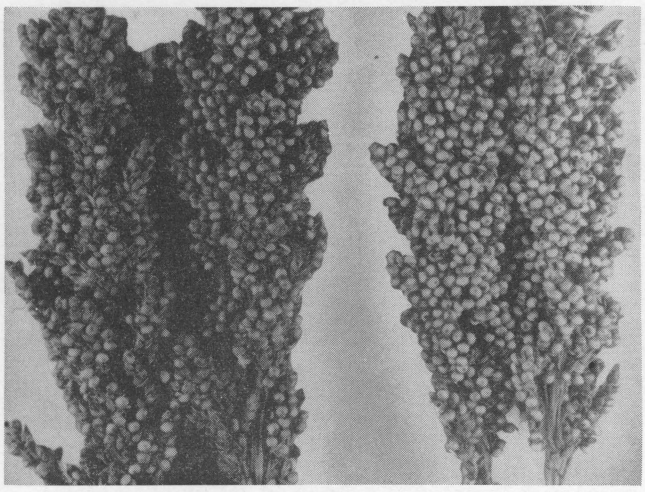

**Figure 2. Treated and nontreated sorghum heads. Left, nontreated, and right, heads treated at the rate of 1¼ gallons of Arasan 42-S per acre.**

tainer were sealed and placed in an oven at 50° C. After weathering 9 days under these conditions, 2 samples of 100 seed each were germinated daily thereafter until the remaining seed were essentially nongerminable.

Since some Arasan 42-S may have washed off the seed in the field after application, additional Arasan 42-S was applied to a portion of seed from each treatment harvested in 1959. Arasan 42-S was applied to seed after harvest in addition to the field treatment to determine whether an extra treatment gave more protection against the fungi associated with seedling development in the germinator and in cold soils. Arasan 42-S was washed off and the seed were planted in cold soil to determine whether treated seed had a higher viability due to the protection against mold in the field or whether the fungicide remaining on the treated seed inhibited fungi development during the laboratory tests.

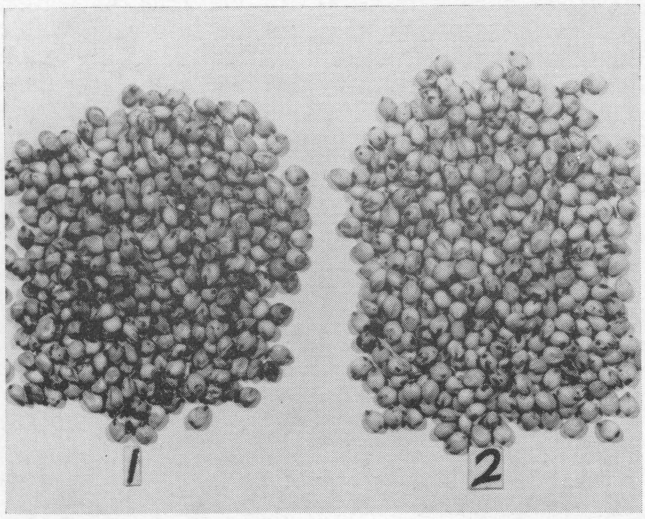


**Figure 3. Sorghum seed (right) treated during milk stage at rate of 1 gallon Arasan 42-S per acre. Untreated seed (left).**

## Results

### *Seed Appearance*

The sorghum that received 1 gallon of Arasan 42-S per acre during the milk growth stages had less mold growth than the check sample in the Prairie View test, but no differences were observed in the treated and check samples when the treatment was applied in the hard dough stage. The lower rates of ½ and ¼ gallon per acre did not reduce mold growth noticeably at either stage of application as compared with the nontreated controls. The light mold infestation in this area during the summer of 1958 could account for the lack of any visible difference in head color when lower rates of Arasan 42-S were used.

Since 1 gallon per acre was superior to all lower rates applied in 1958, the subsequent study in 1959 near College Station involved rates of ¾ and 1¼ gallons per acre. Both rates applied at either the milk or dough growth stages inhibited some mold development. A bright natural coloration appeared on treated sorghum seed, Figure 1. The untreated sorghum heads had discolored seed with mold mycelia covering the kernels, Figure 2. Some seed discoloration was visible on treated heads, but the mold development was more evident in the untreated heads in every test.

### *Deterioration and Viability of Field-treated Sorghum Seed*

The results of viability tests of seed treated in 1958 and given in Table 1. There was no significant difference in the initial germination of seed from the different treatment rates applied at either growth stages. After the seed was stored 1 year and regerminated, there was no difference in germination caused by treatment or stage of growth. The treatment had no apparent effect on the carryover seed when they were subjected to cold test after a year of storage. Figure 3 shows that an application of 1 gallon of Arasan 42-S per acre reduced mold growth when applied in the milk stage, but the data in Table 1 does not indicate that field-treated seed germinated or "carried over" any better in storage than the check sample.

The results of germination tests from seed harvested in 1959 are shown in Table 2. Smaller seedlings were produced from untreated samples, but the differences were not significant since most seedlings were large enough to be considered germinating. Sorghum seed treated at either rate at College Station had considerably less mold growth during the germination period which may have been due to the protection of fungicide remaining on the seed. A slightly higher seedling emergence was evident in seed treated in the field at either stage of growth when these seed were subjected to the cold soil test. It could not be determined from this data whether the in-

TABLE 1. COLD SOIL EMERGENCE OF FIELD-TREATED SORGHUM SEED (1958 HARVEST)

| Stage of maturity[1] | Treatment[2] | Initial germination percentage | Germination percentage and cold soil emergence after 1-year storage | |
|---|---|---|---|---|
| | | | Germination | Cold soil |
| Milk stage | 1 gal./acre | 85.0 | 78.0 | 43.0 |
| Milk stage | 1/2 gal./acre | 84.0 | 76.0 | 49.0 |
| Milk stage | 1/4 gal./acre | 85.0 | 59.0 | 47.0 |
| Milk stage | no treatment | 80.0 | 63.0 | 42.0 |
| Dough stage | 1 gal./acre | 85.0 | 62.0 | 33.0 |
| Dough stage | 1/2 gal./acre | 81.0 | 74.0 | 34.0 |
| Dough stage | 1/4 gal./acre | 80.0 | 75.0 | 42.0 |
| Dough stage | no treatment | 81.0 | 69.0 | 35.0 |
| LSD stages at the .05 level. | | NS | NS | 9.2 |
| LSD rates at the .05 level. | | NS | NS | NS |

[1]Stage of maturity during field application.
[2]Rate of Arasan 42-S per acre.

creased seedling emergence in the cold soil test was due to seed protection in the field by Arasan 42-S or to seed protection during the cold soil test. The result of the cold soil test, after Arasan 42-S was removed, are shown in Table 3. Seed treated in the field with 1¼ gallons per acre produced more vigorous seedlings in cold soil even when Arasan 42-S was removed from the seed before testing. This indicates further that Arasan 42-S protected seed in the field, since any difference in seedling emergence from treated and untreated seed was attributed to Arasan 42-S applied in the field.

The percent viable seed was essentially the same in field treated and nontreated seed after exposure to laboratory weathering conditions, Table 4. High humidity and temperature favored the growth of fungi in the weathering chamber. During the early periods of weathering the field-treated seed seemed to resist mold growth, but after continous weathering, mold development was equally high in both treated and untreated samples. When seed viability became low due to deterioration, the number of germinating seed varied considerably among the treatments.

Field-treated seed that received additional Arasan 42-S treatment after harvest were highly resistant to fungi development and therefore maintained a higher viability during weathering than seed that received only a field treatment, Table 4. All seed decreased in viability after 11 days of weathering. However, when seed received only the field treatment the rate of decrease in viability was extremely rapid. Arasan 42-S applied in the field was not sufficient to resist seed deterioration when exposed to laboratory conditions. The results of laboratory weathering studies of 1-year-old seed harvested in 1958 are shown in Table 5. Although the trend of viability for stored seed was similar to the trend for new seed harvested in 1959, Table 4, the 1-year-old seed deteriorated more rapidly. This may be caused partly by an initial low level of seed viability before weathering.

Seed growers strive to produce bright sorghum seed since farmers prefer it and often receive premium prices for this seed. The results of this experiment show that bright seed can be produced in humid areas with an Arasan 42-S application during the milk or dough stages of sorghum development. Based on the 1958-59 test, a minimum rate of 1 gallon of Arasan 42-S per acre is required to inhibit field mold growth. Early application (milk stage) protected seed against initial invasion of mold. Sorghum treated during the dough stage often had some mold development at application. The degree of mold development, seed discoloration, varies each year

TABLE 2. GERMINATION AND COLD SOIL EMERGENCE OF FIELD-TREATED SORGHUM SEED (1959 HARVEST)

| Stage of maturity[1] | Treatment[2] | Germination percentage and cold soil emergence after harvest | |
|---|---|---|---|
| | | Germination | Cold soil |
| Milk stage | 1¼ gal./acre | 87.5 | 75.0 |
| Milk stage | ¾ gal./acre | 85.0 | 78.0 |
| Milk stage | no treatment | 84.5 | 67.0 |
| Dough stage | 1¼ gal./acre | 86.0 | 71.0 |
| Dough stage | ¾ gal./acre | 78.0 | 73.0 |
| Dough stage | no treatment | 76.5 | 59.0 |
| LSD treatments at the .05 level. | | NS | 8.0 |

[1]Stage of maturity during field application.
[2]Rate of Arasan 42-S per acre.

TABLE 3. SEEDLING EMERGENCE OF FIELD-TREATED SORGHUM SEED AFTER REMOVAL OF ARASAN 42-S BEFORE COLD SOIL TEST

| Stage of maturity[1] | Treatment[2] | Percent seedling emergence |
|---|---|---|
| Milk stage | 1¼ gal./acre | 79.0 |
| Milk stage | ¾ gal./acre | 75.0 |
| Milk stage | no treatment | 74.0 |
| Dough stage | 1¼ gal./acre | 80.0 |
| Dough stage | ¾ gal./acre | 68.0 |
| Dough stage | no treatment | 64.0 |
| LSD stages at the .05 level. | | NS |
| LSD treatments at the .05 level. | | 6.7 |

[1]Stage of maturity during field application.
[2]Rate of Arasan 42-S per acre.

TABLE 4. ARTIFICIAL WEATHERING OF FIELD-TREATED SORGHUM SEED (1959 HARVEST)

| Stage of sorghum maturity[1] | Arasan 42-S treatment[2] | | Initial germination percentage | Germination percentage after days of artificial weathering | | |
|---|---|---|---|---|---|---|
| | Field rate | After harvest | | 9 | 10 | 11 |
| Milk stage | 1¼ gal./acre | none | 85.0 | 87.0 | 57.0 | 21.0 |
| | 1¼ gal./acre | 2 oz./bu. | 84.0 | 85.0 | 84.0 | 53.0 |
| Milk stage | ¾ gal./acre | none | 83.0 | 86.0 | 62.0 | 38.0 |
| | ¾ gal./acre | 2 oz./bu. | 84.0 | 84.0 | 77.0 | 70.0 |
| Milk stage | no treatment | none | 82.0 | 84.0 | 54.0 | 29.0 |
| | no treatment | 2 oz./bu. | 80.0 | 82.0 | 81.0 | 69.0 |
| Dough stage | 1¼ gal./acre | none | 86.0 | 89.0 | 66.0 | 36.0 |
| | 1¼ gal./acre | 2 oz./bu. | 88.0 | 88.0 | 81.0 | 77.0 |
| Dough stage | ¾ gal./acre | none | 83.0 | 78.0 | 46.0 | 35.0 |
| | ¾ gal./acre | 2 oz./bu. | 82.0 | 77.0 | 81.0 | 80.0 |
| Dough stage | no treatment | none | 81.0 | 83.0 | 59.0 | 36.0 |
| | no treatment | 2 oz./bu. | 78.0 | 83.0 | 74.0 | 64.0 |

[1]Stage of maturity during fungicide application in the field.
[2]Portion of each sample received additional treatment after harvest.

according to weather conditions, and seedsmen can not tell in advance how critical it will be. In normal years, beneficial results may be obtained with lower rates, ½ and 1 gallon per acre, while repeated applications of 1 and 1¼ gallons per acre may be necessary in years of above normal humidity and rainfall.

In this study, Arasan 42-S was applied to sorghum grown for seed purposes. *Do not use Arasan 42-S on plant parts to be used for food or feed.*

Arasan 42-S had a greater effect on maintaining the natural seed color than in the actual improvement of seed viability. The benefit to seed from Arasan 42-S usually was associated indirectly with reduction of fungi and soil organism during the germination and cold soil test. However, seed treated with rates of 1¼ gallons per acre produced more vigorous seedlings even when Arasan 42-S was removed before cold testing. This indicates that Arasan 42-S applied at higher rates gave some protection to the viability of seed in the field.

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TABLE 5. ARTIFICIAL WEATHERING OF FIELD-TREATED SORGHUM SEED (1958 HARVEST)

| Stage of sorghum maturity[1] | Arasan 42-S treatment[2] | | Initial germination percentage | Germination percentage after days of artificial weathering | | |
|---|---|---|---|---|---|---|
| | Field rate | After harvest | | 9 | 10 | 11 |
| Milk stage | 1 gal./acre | none | 78.0 | 62.0 | 37.5 | 27.0 |
| | 1 gal./acre | 2 oz./bu. | 75.0 | 63.0 | 40.0 | 34.0 |
| Milk stage | ½ gal./acre | none | 76.0 | 55.0 | 40.0 | 28.0 |
| | ½ gal./acre | 2 oz./bu. | 72.5 | 58.0 | 46.0 | 35.0 |
| Milk stage | ¼ gal./acre | none | 59.0 | 43.0 | 35.0 | 13.0 |
| | ¼ gal./acre | 2 oz./bu. | 66.0 | 57.5 | 38.0 | 24.0 |
| Milk stage | no treatment | none | 63.0 | 49.0 | 28.0 | 20.0 |
| | no treatment | 2 oz./bu. | 68.0 | 59.0 | 45.0 | 31.0 |
| Dough stage | 1 gal./acre | none | 62.0 | 39.0 | 21.0 | 17.0 |
| | 1 gal./acre | 2 oz./bu. | 65.0 | 46.0 | 33.0 | 25.0 |
| Dough stage | ½ gal./acre | none | 74.0 | 48.0 | 35.5 | 24.0 |
| | ½ gal./acre | 2 oz./bu. | 73.0 | 53.0 | 42.0 | 27.5 |
| Dough stage | ¼ gal./acre | none | 75.0 | 48.0 | 34.0 | 30.0 |
| | ¼ gal./acre | 2 oz./bu. | 77.0 | 55.0 | 40.0 | 36.0 |
| Dough stage | no treatment | none | 69.0 | 43.0 | 31.5 | 22.5 |
| | no treatment | 2 oz./bu. | 72.0 | 48.5 | 38.0 | 33.0 |

[1]Stage of maturity during fungicide application in the field.
[2]Portion of each sample received additional treatment after harvest.