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Brief Articles

EFFECTS OF ULTRA-LOW VOLUME AND CONVENTIONAL SPRAY APPLICATIONS OF IN-COVERING-SOIL FUNGICIDES ON COTTON STANDS[1]

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ABSTRACT

Ultra-low volume (ULV) applications in covering soil over cotton (*Gossypium hirsutum* L.) seed at planting of emulsifiable concentrates of pentachloronitrobenzene + 5-ethoxy-3-trichloromethyl-1,2,4-thizadiazole or 1-chloro-2-nitropropane + pentachloronitrobenzene performed as well as, or better than, an equivalent dosage of the fungicides applied in 15.3 liters of water/ha. Phytotoxicity was not associated with ULV applications of fungicides. Only one fungicide treatment (1-chloro-2-nitropropane + pentachloronitrobenzene) inceased final stand significantly when compared with the check. All fungicide treatments slightly reduced the rate of seedling emergence, as measured by the coefficient of velocity of emergence; conventional spray application was associated with the greatest reduction in emergence rate.

Additional index words: **Seedling disease, Velocity of emergence, Rate of emergence, *Gossypium hirsutum* L.**

SINCE 1963, the annual estimated reduction in yield caused by seedling diseases of cotton (*Gossypium hirsutum* L.) on the South Plains of Texas ranged from 2.5% to 4.5%, with a 7-year average of 3.4%. Prior to 1950 major emphasis in seedling-disease research was placed on seed treatments. As seed-borne pathogens can be reduced by commercial delinting, grading of cottonseed, and seed-applied fungicide, our main concern now is control of soil-borne pathogens that infect seedlings.

Methods of applying in-covering-soil fungicides were developed about 10 years ago (1, 2, 4, 5, 6). Use of soil fungicides is a practical, effective, and economical way to reduce losses from seedling diseases and to increase yields (4, 5). However, this practice has not been widely accepted by cotton producers on the South Plains of Texas probably due to the extra time required to mix and apply high rates of fungicide suspensions at planting and the cost of equipment. Also, weight of fungicide emulsions is a problem when 15 liters of solution/ha are applied with 4- to 8-row planting equipment.

The objective of the test reported here was a comparison of the effects of ultra-low volume (ULV) and conventionally applied (CA) sprays of in-covering-soil fungicides on seedling emergence and stand count.

Materials and Methods

A 4-row lister planter was used to plant the test on the Texas A&M University Agricultural Research and Extension Center at Lubbock. A sprayer equipped with three flat spray nozzle tips, Spraying Systems Co. number 73007,[3] per row was used to apply diluted fungicides for the conventional treatments (1, 6). One nozzle was arranged vertically so that the fungicide emulsion was directed in the seed furrow, behind the opening shoe but ahead of the seed press wheel. Two additional nozzles were positioned horizontally so that the fungicide emulsion was sprayed on the covering soil as it was rolled into the seed furrow by the covering drags.

A Pneu-Mist ultra-low volume sprayer (Magnolia Agricultural Supply, Jackson, Miss.) was used to apply undiluted emulsifiable concentrate (EC) fungicides for the ULV treatments. One nozzle per row positioned behind the seed press wheel applied the chemicals to both the seed furrow and to the covering soil as it was rolled into the seed furrow. The nozzle consisted of Spraying Systems Co. liquid cap number 1050 and air cap number 67228-45. EC fungicides were forced from a 4.6-liter tank and atomized at the nozzle by compressed air. The degree of atomization and the spray volume were controlled by air pressure that ranged from 8 to 18 psi.

Commercially produced, processed (acid delinted), and treated (alkyl mercury) cottonseed of 'Dunn 56C,' *Gossypium hirsutum* L., were planted 5 cm deep at the rate of 19.6 kg/ha. The experimental design was a randomized complete block with six replications. Each plot was 4.1 m (four rows) wide by 22.6 m long. The soil type was Amarillo loam. Prior to planting, *a,a,a,*-trifluoro-2,6-dinitro-*N,N*-dipropyl-*P*-toluidine (trifluralin) was applied at 0.67 kg/ha and disc-incorporated 10 cm deep.

The fungicide treatments consisted of a combination of pentachloronitrobenzene + 5-ethoxy-3-trichloromethyl-1,2,4-thizadiazole (PCNB + Terrazole)[4] or 1-chloro-2-nitropropane + pentachloronitrobenezene (Lanstan + PCNB)[4] and an untreated check.

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[3] Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the US Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable.

[4] PCNB + Terrazole contained 240 + 60g active ingredient/liter and Lanstan + PCNB contained 360 + 180g active ingredient/liter, respectively.

Fungicide emulsions were applied at 15 liters/ha with the conventional sprayer, or undiluted EC formulations of PCNB + Terrazole and Lanstan + PCNB were applied at 0.77 and 0.51 liter/ha, respectively. Equivalent dosages of fungicide were applied with the two sprayers.

Stand counts were made from 9.3 m of row, midway of the plot. Two hundred and thirty seeds were planted in the area used for stand counts. Coefficients of velocity of emergence (CVE) were calculated by the method of Leach (3).

Results

There were significant differences in stands among the treatments at 8, 9, 10, and 14 days after planting (Table 1). PCNB + Terrazole and Lanstan + PBNB applied as ULV sprays gave higher stand counts than the CA. At 8 and 9 days after planting all plots receiving fungicides applications, except those receiving ULV Lanstan + PBNB, had lower seedling emergence than untreated check. At 12 days after planting there were no significant differences in stand counts among the treatments. At 14 days following planting stand counts were definitely higher for plots receiving ULV than for those receiving CA fungicide applications. All fungicide treatments did not increase stand counts significantly over the untreated check, since post-emergence damping-off was low, due to favorable environmental conditions for growth of cotton seedlings.

ULV application of each fungicide gave slightly higher CVE values than CA with the CVE for Lanstan + PCNB treated plots higher than that of any other fungicide treatment.

Data from five additional tests either confirmed the data reported herein, or there were no significant differences among the final stand counts for treatments. In most tests ULV application of fungicides gave consistently higher stands than CA. In tests where stands were not increased by in-covering-soil fungicides environmental conditions were ideal for rapid germination of seed and the emergence and growth of seedlings.

Table 1. Cumulative number of live plants per 9.3-m linear row and coefficient of velocity of emergence (CVE) for rates of solution-concentration of in-covering-soil fungicides planted May 15, 1968.

Treatment	Active ingredient, kg/ha	Spray emulsion, liters /ha	Number of plants, Days after planting* 8	9	10	12	14	CVE*
Untreated check	-	-	29 b	72 a	94 b	114 a	116 b	10.9 a
PCNB + terrazole	.89 + .22	0.7	18 c	53 b	84 c	116 a	120 b	9.9 cd
PCNB + terrazole	.89 + .22	15.0	9 d	39 c	72 d	108 a	110 c	9.7 d
Lanstan + PCNB	.89 + .44	0.5	40 a	81 a	103 a	121 a	127 a	10.5 ab
Lanstan + PCNB	.89 + .44	15.0	15 c	60 b	92 b	110 a	116 b	10.1 bc

* Column means followed by the same letter for each date are not significantly different at the .05 level of probability using Duncan's Multiple Range Test.

Discussion

Differences among stand counts for ULV and conventional methods of fungicide application appeared to be related to a high level of soil moisture. Reduction in the rate of seedling emergence and final stands for the conventional method of application may be related to reduced oxygen content and soil temperature in the seed row, to more severe preemergence seedling diseases, and to poor contact of the seed with the covering soil. The emulsions were applied to an area of soil about 5 cm wide and 5 cm deep. Fifteen liters of emulsion/ha increased the moisture content of the covering soil considerably, causing the soil to ball up on the seed press wheel.

ULV applications of fungicides gave more rapid rates of seedling emergence and generally higher final stands than those of CA. This suggests that the EC formulations of the fungicides were not toxic to cottonseed and seedlings. Other workers have shown that early seedling emergence was directly related to high yield (7).

Each year a high percentage of the cotton acreage is planted on the South Plains of Texas before or soon after the soil temperature reaches the minimum recommended for cotton. Soil moisture is usually high at this time. Early planting of cottonseed is essential, since the length of the growing season on the South Plains is limited. Furthermore, in this region the development of the cotton plant is delayed by low night temperatures during the season, and by cool day temperatures during the spring and fall. My own unpublished data indicate that seedling emergence is inhibited by the sudden drop in air temperature. Although short periods of cool weather do not appear to affect soil temperature at the 20-cm depth, there can be a significant temperature drop at seed depth.

Advantages of ULV application, as compared to conventional application of in-covering-soil fungicides, are: *(1)* faster emergence of seedling; *(2)* higher percentage of seedling emergence; *(3)* need of less labor to prepare and apply fungicide emulsions; *(4)* use fungicide containers as spray tanks; *(5)* reduced weight of planting equipment. The major disadvantage of ULV fungicide application is the necessity of very precise sprayer calibration, since the difference between rates that give satisfactory disease control and rates that are phytotoxic is very narrow. Also, application of wettable powder formulations may not be feasible, since the nozzle orifice limits particle size.

References

1. Alfred, W. H., L. H. Wilkes, and L. S. Bird. 1961. Spray nozzle arrangements for the application of soil chemicals at planting for seedling disease control in cotton. Texas Agr. Exp. Sta. Prog. Rep. 2181. 3 p.
2. Godfrey, G. H. 1953. Effectiveness of soil fungicides in controlling cotton seedling diseases in the Lower Rio Grande Valley. Texas Agr. Exp. Sta. Prog. Rep. 1602. 3 p.
3. Leach, L. D. 1947. Growth rates of host and pathogen as factors determining the severity of preemergence damping-off. J. Agr. Res. 75:161-179.
4. Maier, C. R. 1961. In-the-furrow application of soil fungicides for control of cotton seedling disease. Plant Dis. Rep. 45:276-280.
5. Ranney, C. D., and L. S. Bird. 1958. Influence of fungicides, calcium salts, growth regulators, and antibiotics on cotton seedling disease when mixed with the covering soil. Plant Dis. Rep. 42:785-791.
6. ———, and A. M. Hillis. 1958. Methods of applying fungicides in the covering soil at planting for control of seedling disease of cotton. Texas Agr. Exp. Sta. Prog. Rep. 2001. 3 p.
7. Wanjura, D. F., E. B. Hudspeth, Jr., and J. D. Bilbro, Jr. 1969. Emergence time, seed quality, and planting depth effects on yield and survival of cotton (*Gossypium hirsutum* L.). Agron. J. 61:63-64.