THE EFFECT OF A VARYING RATES OF METHAM AND APPLICATION TECHNIQUE ON NUTSEDGE CONTROL AND COTTON VIGOR

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Abstract

The effects of metham on nutsedge control and cotton vigor were examined. Metham was applied as a preplant fumigant at 25, 45, and 65 gallons per treated acre. Each rate of metham was applied using three different application techniques; a single spray blade (SSB), fertilizer shanks (Fert.), and a triple spray blade (TSB).

All metham treatments provided excellent nutsedge control for 21days (89-100% control). There were minor differences in nutsedge control among the three types of shanks used. Only the 65 gallon per treated acre rate provided acceptable nutsedge control (77%) for 44 days. Increasing rates reduced seedling disease and increased seedling vigor. Although metham reduced weed competition, it also reduced the percentage of roots infected with mycorrhiza fungi. As a result, seedling phosphate levels were significantly lower in all metham treatments than the untreated control. However, this effect was only temporary in that by the first bloom evaluation, phosphate levels in metham treatments were equivalent to that of the untreated control. Tissue analyses were also evaluated for nitrogen, potassium, and zinc; however, differences were minor. A mid-season soil sample was taken to determine nutsedge tuber counts and distribution in the soil profile. All metham treatments seemed to have higher tuber counts than the untreated control, with the exception of the triple spray blade in the top eight inches of soil.

Introduction

In California cotton, purple nutsedge is one of the most persistent and difficult weeds to control. Purple nutsedge is commonly found in moist sandy soils throughout the San Joaquin Valley. It is a perennial that can reproduce via rhizomes or seed, however, it predominantly reproduces by rhizomes. It is estimated that in California there are 150 thousand acres infested with weeds of the Cyperus genera. Since 1990, the percent reduction in yields due to Cyperus spp. has risen from 15 percent to 19 percent (Byrd 1993). The increased presence of purple nutsedge is due to the lack of sound sanitary practices, crop rotation, and selective postemergence herbicides that kill purple nutsedge without severely affecting cotton seedling vigor. Typically, fields severely infested with purple nutsedge produce poor stands that result in reduced yield. Because of its ability to infest the seed row, hand hoeing is not a cost effective method of control for purple nutsedge.

The current method of control is a broadcast application of MSMA. MSMA provides good control of purple nutsedge; however it may cause severe stunting, decreased seedling vigor, and reduced yield. Wright and Vargas demonstrated the effectiveness of metham against purple nutsedge in the seed row.

Metham is a soil fumigant, which is used to kill germinating weed seeds, underground vegetative plant parts, nematodes, bacteria and fungi. Upon contact with moist soil metham breaks down, forming methyl-isothiocyanate, a highly volatile and toxic compound. After application, methyl-isothiocyanate vapor dispersal occurs within 1-5 hours and dissipates from the soil within 2-3 weeks.

Using metham for purple nutsedge suppression provides a weed-free period for cotton stand establishment and reduces soil borne pathogens. The use of metham has had some detrimental effects. Occasionally, metham causes stunting of seedlings as a result of mycorrhizal fungi mortality.

Due to its competitiveness and its ability to reproduce, purple nutsedge has become a very important weed of cotton. There fore, alternative management methods for purple nutsedge control are in high demand.

Materials and Methods

This study was a randomized complete block, with four replications. Plot size was two - 30 inch rows by 1250 feet. Metham was applied on April 5, as a preplant fumigant. The cotton was planted April 22. Three different types of shanks were used and evaluated at 0, 25, 45, and 65 gallons per treated acre. The three types of shanks used were as follows: single spray blade (SSB), applied at a depth of 4 inches; fertilizer shanks - two per row (Fert.), applied at a depth of 4 to 10 inches; and a triple spray blade (TSB), applied at a depth of 4 to 12 inches. Applications were made to pre-irrigated, pre-formed beds in an 8 inch band. All metham treatments were covered with a 6 inch soil cap, to prevent volatilization.

Plant population was based counts of one thousandth of an acre. Percent nutsedge control was visually evaluated. Mycorrhizal infection was evaluated on a sample of 25 seedlings per plot. Roots were removed and a sub sample was taken to evaluate each plot. Seedling disease rating was based on a sample of 25 plants per plot, and scored on a scale of 0 to 4; 0, exhibition no symptoms of disease and 4, exhibiting severe disease symptoms. Tissue analysis was based on petiole sampling at the physiological stages of first bloom, peak bloom and cut out. Additional tissue

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samples were taken at the seedling stage to observe the effect of mycorrhizal death on uptake of nutrients. Soil sampling with a sand agar (3 inch diameter) was performed to determine distribution of purple nutsedge tuber counts and distribution in the soil profile. Samples were taken at increments of four inches in depth, down to 20 inches. Ten soil samples were taken per plot, per depth.

Results and Discussion

All metham treatments provided excellent control of purple nutsedge for 21 days (Table 1). There were minor differences in nutsedge control between application methods (Table 1). The 65 gallon per treated acre rate provided 70 to 75% control of nutsedge for 44 days (Table 1). Increasing rates of metham reduced severity of seedling disease (Figure 1). In addition, increasing rates increased seedling vigor, but had minor effects on plant population (Table 2). All metham treatments reduced mycorrhizal infection and seedling phosphate levels (Table 3). All metham treatments seemed to have higher tuber counts than the untreated control, with the exception of the triple spray blade in the top eight inches of soil (Figures 3,4,5,6,7). The distribution of tubers in the soil profile was 34% (0-4") , 39% (4-8"), 19% (8-12"), 6% (12-16"), and 2% (16-20") (Figure 8). There were minor differences in tissue levels of N, P, K, and Zn (Tables 4,5,6,7). There were no differences in plant monitoring. All metham treatments slightly reduced yield (Figure 2).

References

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2. Byrd, J.D. (1993). Report of the 1992 Cotton Weed Committee. In 'Proceedings of the Beltwide Cotton Conference, 17th Cotton Weed Science Research Conference'. pp.1535-1537. (National Cotton Council of America)

3. Wright, S., and R. Vargas, 1994. Metham for cotton weed control. World Cotton Conference. Australia

4. Wright, S., and R. Vargas. 1995. Metham for cotton weed control. California Cotton Review.

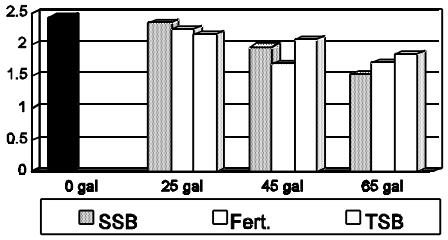

Figure 1. Seedling Disease (scale = 0-4)

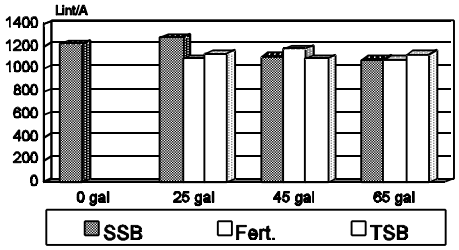

Figure 2. Effect of Metham on Yield

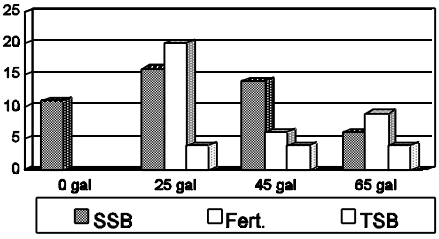

Figure 3. Tubers at 0-4" Depth

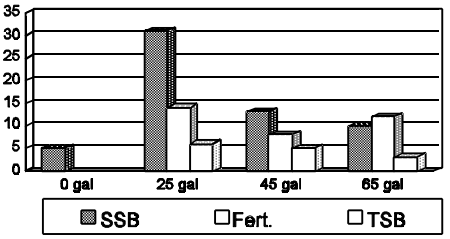

Figure 4. Tubers at 4-8" Depth

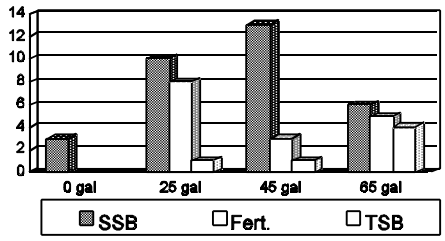

Figure 5. Tubers at 8-12" Depth

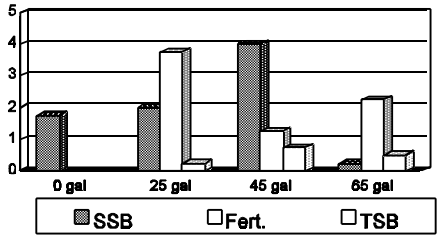

Figure 6. Tubers at 12-16" Depth

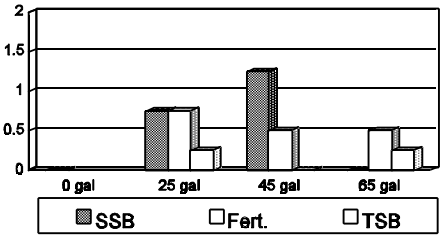

Figure 7. Tubers at 16-20" Depth

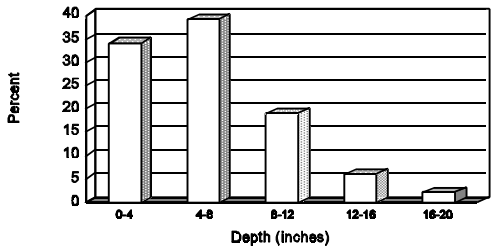

Figure 8. Nutsedge Tuber Distribution

Table 1. % Purple Nutsedge Control

	21 DAT	29 DAT	36 DAT	44DAT	50 DAT
SSB 25gal	89	44	25	19	14
SSB 45gal	96	73	55	36	38
SSB 65gal	100	89	81	73	59
Fert. 25gal	93	46	20	11	5
Fert. 45gal	96	81	58	51	35
Fert. 65gal	99	88	78	70	61
TSB 25gal	91	55	26	23	13
TSB 45gal	91	69	56	48	33
TSB 65gal	96	86	83	75	69
Control	0	0	0	0	0
LSD .05	9	11	12	18	16
% CV	7.2	12.4	17.4	30.7	34

Table 2. Plant Population and Seedling Vigor

	Plants/A	Plant Ht	Dry wt. (grams)
SSB 25 gal	77,380	6	14.3
SSB 45 gal	75,540	6	15.2
SSB 65 gal	71,620	6.3	15.6
Fert. 25 gal	73,120	5.6	12.8
Fert. 45 gal	75,920	6.3	17.2
Fert. 65 gal	76,330	6.3	17.1
TSB 25 gal	79,960	6.4	15.1
TSB 45 gal	80,420	6.7	17.0
TSB 65 gal	71,250	6.7	16.6
Control	74,040	5.9	13.9
LSD .05	7,796	.7	3.1
% CV	7.11	7.23	13.7

Table 3. % Mycorrhizal Infection and PO_4 Levels

	% Mycorrhizal Infection	Seedling Petiole	PO_4 Seedling Shoot	First Bloom
SSB 25gal	4.11	770	1320	1313
SSB 45gal	11.65	660	1110	1330
SSB 65gal	2.52	630	980	1283
Fert. 25gal	—	820	1073	1340
Fert. 45gal	—	700	1315	1333
Fert. 65gal	—	570	1090	1335
TSB 25gal	—	760	1383	1285
TSB 45gal	—	640	970	1363
TSB 65gal	—	630	983	1338
Control	19.14	1180	1948	1308
LSD .05	10.91	—	392	NS
% CV	90	—	22.2	11.1

Table 4. NO_3-N (ppm)

	Seedling	First Bloom	Peak Bloom	Cut Out
SSB 25 gal	2105	6513	4375	1633
SSB 45 gal	2888	6115	4130	1553
SSB 65 gal	2080	6820	4640	1925
Fert. 25 gal	2465	6480	3603	1553
Fert. 45 gal	2513	6978	4263	1053
Fert. 65 gal	2475	5903	4715	1205
TSB 25 gal	2308	6103	4535	1040
TSB 45 gal	3118	5003	3143	818
TSB 65 gal	3558	6135	4275	800
Control	1983	6755	4535	1033
LSD .05	875	1474	1534	856
% CV	23.7	16.2	25.1	46.8

Table 5. PO_4-P (ppm)

	Seedling	First Bloom	Peak Bloom	Cut Out
SSB 25 gal	1320	1313	765	1050
SSB 45 gal	1110	1330	803	1033
SSB 65 gal	980	1283	865	1145
Fert. 25 gal	1073	1340	588	1013
Fert. 45 gal	1315	1333	798	1078
Fert. 65 gal	1090	1335	783	1178
TSB 25 gal	1383	1285	735	1188
TSB 45 gal	970	1363	735	1155
TSB 65 gal	983	1338	678	1073
Control	1948	1308	733	975
LSD .05	392	NS	220	203
% CV	22.2	11.1	20.3	12.9

Table 6. % K

	Seedling	First Bloom	Peak Bloom	Cut Out
SSB 25 gal	2.22	4.33	3.24	2.60
SSB 45 gal	2.27	4.11	3.26	2.68
SSB 65 gal	2.22	3.55	3.33	2.70
Fert. 25 gal	2.16	4.19	2.27	2.46
Fert. 45 gal	2.30	4.39	3.10	2.23
Fert. 65 gal	2.21	4.21	3.23	2.57
TSB 25 gal	2.31	4.16	3.17	2.42
TSB 45 gal	2.38	4.27	3.06	2.35
TSB 65 gal	2.43	4.3	3.17	2.40
Control	2.17	4.34	3.28	2.44
LSD .05	NS	.68	.75	NS
% CV	10.8	11.3	16.6	14.2

Table 7. Zn (ppm)

	Seedling	First Bloom	Peak Bloom	Cut Out
SSB 25 gal	25.3	18.0	13.5	15.5
SSB 45 gal	39.3	19.0	14.8	16.8
SSB 65 gal	22.8	18.0	14.8	16.8
Fert. 25 gal	24.0	19.5	10.5	15.5
Fert. 45 gal	39.5	20.5	13.5	17.3
Fert. 65 gal	24.0	17.8	14.0	15.0
TSB 25 gal	24.5	17.5	13.0	15.0
TSB 45 gal	22.5	16.8	----	15.0
TSB 65 gal	22.8	17.5	12.3	14.8
Control	29.0	18.5	14.0	15
LSD .05	NS	3.0	3.3	NS
% CV	56.1	11.3	17.0	11.3