Table 9. AVERAGE EFFECTS OF OILS AT ALL RATES ON APPEARANCE RATINGS[1] OF ARGENTINE BAHIAGRASS, AUGUST 1965

Oil	Appearance Ratings
SS TS	7.6
SS 38	8.0
SS 91	7.9
SSP 7	8.5
SSP 11	8.5
SSP 17	8.6
SFC 100	8.6
Checks	9.0
LSD: .05	.01
Between oils .3	.5

[1]Rating scale - 9 = No toxicity to 1 = Complete kill

Table 10. AVERAGE EFFECTS OF REPEAT APPLICATIONS OF OILS ON APPEARANCE RATINGS[1] OF ARGENTINE BAHIAGRASS, AUGUST 1965

Rates	Repeat Applications Means						
All	Rating Dates						
Rates	Check	8-2	8-10		8-18		
of		1X	1X	2X	1X	2X	3X
Oils	9.0	8.8	8.7	7.4	9.0	8.3	7.0
LSD:			.05	.01			
Between repeat application means			.5	.9			

[1]Rating scale - 9 = No toxicity to 1 = Complete kill

cantly when initial treatments of all oils (X) at all rates and dates were combined. Phytotoxic effects on 'Argentine' bahiagrass were increased when treatments were re-applied after 7 days (2X) and rated 2 or 3 days later. This increased toxicity was highly significant. A third repeat application produced an additional highly significant increase in toxicity. These data show that repeated applications of oils, at weekly intervals, produced increased phytotoxic effects on 'Argentine' bahiagrass.

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INCREASING THE EFFECTIVENESS OF TURF HERBICIDES BY USE OF OIL

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ABSTRACT

A split-split plot experiment was used to determine the effects of 6 herbicides at various rates with and without oil on phytotoxicity of established sod, young sprigs and seedlings and preemergence and postemergence weed control.

Tolerance of grasses to the herbicide or herbicide-oil combination varied with the herbicide and rate used. Addition of 2 gpa of sunspray 11EL oil to the herbicides used in this experiment resulted in significantly better or equal weed control when herbicide rates were equal (in case of Banvel D) or reduced one-half (the only exception was Amchem 63-303).

Results of this experiment indicate that excellent weed control can be accomplished by adding 2 gpa of oil to one-half the presently recommended rates of prometryne, atrazine, DSMA or MSMA. Oil mixed with the recommended herbicides at one-half the recommended rate did not increase the toxicity to established sod of any of the grasses tested. The oil-herbicide combination should not be used on seedlings or young plantings.

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INTRODUCTION

Extensive research on chemical herbicides for controlling weeds in warm season turfgrasses has been conducted during the past 5 years

(1,2,3,4,5,6,9,10,12). New herbicides have been introduced during this period.

Simazine and atrazine were first recommended for preemergence weed control in turf in 1960 (6). Rates of simazine and atrazine up to 5 pounds of active per acre (#ai/A) were recommended for organic soils and 2 pounds ai/A on mineral soils.

Phenoxy-type herbicides such as 2,4-D, 2,4 DB, 4(2,4-DB) and 2,4,5-T, have been recommended for postemergence control of broadleaf weeds in all warm season turfgrasses, except St. Augustine, since 1953 (11). Arsenic-containing compounds such as disodium methyl arsonate (DSMA), ammonium methyl arsonate (AMA) and monosodium methyl arsonate (MSMA) were reported effective for postemergence control of grassy weeds in bermuda and zoysia grasses (11).

The herbicides recommended above are selective pre- or postemergence herbicides. Nonselective herbicides such as spray oils, mineral spirits, gasoline, diesel oil, di-nitro and pentacholoro-phenol (liquid flame) have been recommended for general weed control (1,2,7,8,9,10,-11,13). These materials are recommended for their quick killing effects on the tops of weeds; however, some are translocated, which resulted in root kill, especially at higher rates (7,8,10,13). Usually, a preemergence herbicide, such as simazine, is added to kill germinating weed seed.

An earlier experiment with oils resulted in an observed high toxicity of oil to spotted spurge, *Euphorbia mutans*. This observation, plus finding that warmseason turfgrasses would tolerate low rates of oils, led to an experiment to determine the effects of oil on the activity of several turf herbicides. The object of this experiment was to determine if lower rates of recommended herbicides and combinations with oil would give effective weed control without additional damage to turf.

Materials and Methods

A split-split plot experiment with 3 replications was started in August, 1965 and terminated in February, 1966. It was to determine the effects of recommended herbicides alone and in combination with oil on tolerance of established sod, newly sprigged or seeded areas and pre- and postemergence control of weeds.

Main-plot treatments were the following grass varieties: 'Argentine' and 'Pensacola' bahia; 'Ormond,' 'Tifgreen' and 'Tiflawn' bermuda; cenetipede; St. Augustine; 'Emerald' and 'Meyer' zoysia. Main plots were 36' x 90' and were made up on 9 ten-feet strips of grass, 36' wide.

Sub-plot treatments were; a strip of sod 2 feet wide, a 4-foot strip of seeded or sprigged grass (except centipede grass, which had a 2-foot strip of sprigged and 2-foot strip of seeded grass), a 2-foot strip of freshly hoed soil and a 2-foot strip of established weeds. Sub-plots were 2' x 36.' Sod was laid one month before herbicide treatments were applied, and seed and sprigs were planted at recommended rates 2 days prior to application of herbicides. The clean, cultivated strip was hoed and raked one day prior to treatment. Established weeds were mowed weekly at a 3-inch height of cut.

Sub-sub plots were 18 treatments of recommended rates of herbicides (Table 1) with and without oil and at reduced rates with oils. Herbicides selected were Banvel D, Prometryne, Atrazine, DSMA, MSMA + 2,4-D and Amchem 63-303. Sunspray 11EL oil at the rate of 2 gpa was used. One foot strips of each herbicide treatment were sprayed across strips of sod, seed, sprigs, clean area and established weeds of the 9 main plots. One foot checks were left on each side of the treated area to evaluate weed kill and phytotoxicity to sod, seedlings, sprigs and for pre- and postemergence weed control ratings. Each plot was 1' x 2' with an untreated check of the same size on each side. Treatments were replicated 3 times.

Banvel D was the only herbicide used at the same rate with and without oil. The other herbicides were used at recommended rates without oil and at one-half, one-fourth, one-sixth or one-eighth the recommended rate with 2 gpa of oil.

Fertilization, pest control, mowing and other management programs were according to recommended practices.

All herbicide treatments were applied as sprays with a 3-gallon pressure sprayer equipped with a pressure regulator. Pressure and walking speed were adjusted to deliver 40 gpa of the spray-herbicide mixture using a 8004 TeeJet nozzle. All herbicides were applied the same day.

Evaluation included ratings on tolerance of sod, seedlings and sprigs to herbicides with and without oil. Preemergence weed control responses were evaluated from the clean strips, and

postemergence weed control ratings were made on the established weed plots as well as in the sprigged and seeded areas. No effort was made to evaluate specific weeds controlled other than the broad classification of grass and broadleaf weed control. A rating scale from 9 (no damage to sod, turf seedlings, turfgrass sprigs or weeds killed) to 1 (complete kill of sod, turf seedlings or weeds) was used.

Results and Discussion

Tolerance of Established Sod to Herbicides

Grasses used in this experiment were found to be quite variable in tolerance to herbicides used. Significant differences in tolerance to herbicides were found between genera but none between varieties within a genus. Arsenicals have been used to kill grassy weeds (*including* centipede, St. Augustine and bahia grasses) in bermuda and zoysia turf for several years. This selectivity is shown by comparing the poor tolerance of 'Argentine' and 'Pensacola' bahia sod (Table 1) with good tolerance of bermuda and zoysia sod (Tables 2 and 5) to 6 lbs. ai/A MSMA and complete kill of centipede sod at the same rate.

Bahiagrasses—'Argentine' bahia sod was tolerant to Banvel D, prometryne and atrazine with and without oil (Table 1). DSMA and MSMA at all rates, with and without oil, were highly toxic to both 'Argentine' and 'Pensacola' bahia sod. MSMA plus 2,4-D at both rates tested was highly toxic to 'Argentine' and 'Pensacola' bahia sod. Amchem 63-303 at 8 pounds ai/A was highly toxic to bahia sod (Table 1). Rates

Table 1. TOLERANCE RATINGS[1] OF BAHIAGRASS SEEDLINGS AND SOD AFTER TREATMENT WITH VARIOUS HERBICIDES ALONE AND IN COMBINATION WITH OIL

TREAT. NO.	TREATMENTS	RATE OF: Herb. #ai/A	RATE OF: Oil gpa	GRASS 'Argentine' Seedlings	GRASS 'Argentine' Sod	GRASS 'Pensacola' Seedlings	GRASS 'Pensacola' Sod
1.	Banvel D	½	0	4.7	9.0	4.7	8.7
2.	Banvel D + Oil	½	2	1.0	8.7	1.0	9.0
3.	Prometryne	2	0	3.9	8.7	2.0	8.0
4.	Prometryne + Oil	1	2	3.0	9.0	2.0	8.0
5.	Atrazine	2	0	1.3	8.7	1.0	7.7
6.	Atrazine + Oil	1	2	2.0	8.0	1.3	7.3
7.	DSMA	6	0	1.7	4.7	3.3	5.3
8.	DSMA + Oil	3	2	4.3	4.0	4.3	4.3
9.	DSMA + Oil	1	2	5.0	5.7	7.0	6.3
10.	MSMA	6	0	1.0	3.0	1.3	3.0
11.	MSMA + Oil	3	2	1.3	2.0	2.0	1.7
12	MSMA + Oil	1	2	4.9	4.7	5.0	6.0
13.	MSMA + 2,4-D	4+½	0	1.0	3.7	1.3	3.3
14.	MSMA + 2,4-D + Oil	1+½	2	2.0	4.0	1.0	5.0
15.	Amchem 63-303	8	0	1.3	6.7	1.3	6.0
16.	Amchem 63-303 + Oil	4	2	2.7	9.0	1.3	7.0
17.	Amchem 63-303 + Oil	1	2	5.0	9.0	5.3	8.3
18.	Check (Oil Alone)	-	-	9.0	9.0	9.0	9.0
LSD		.05	.01				
	Between treatments	1.1	1.7				

[1]Rating scale - 9 = No damage to sod or seedlings to 1 = Complete kill

of 4 and 1 pounds ai/A of Amchem 63-303 plus oil were not toxic to 'Argentine' bahia sod; however, the 4 pounds ai/A rate was toxic to 'Pensacola' bahia sod (Table 1).

Addition of 2 gpa of oil to ½ pound ai/A of Banvel D resulted in no significant increased toxicity to bahiagrass sod. Plots receiving prometryne and atrazine at 1 pound ai/A with oil were no more or less toxic to bahia sod than 2 pounds ai/A of either without oil. Plots receiving DSMA or MSMA at 3 pounds ai/A with oil were not different from plots receiving 6 pounds ai/A without oil. However, the 1 pound ai/A rate of both DSMA and MSMA with oil resulted in significantly less toxicity to bahiagrass sod. MSMA at both 4 and 1 pounds ai/A plus ½ pound ai/A 2,4-D with and without were highly toxic to bahiagrass sod when compared to checks. One pound of MSMA plus 2,4-D with oil was significantly less toxic to 'Pensacola' bahia (Table 1).

Bermudagrass—Plots of 'Ormond,' 'Tifgreen' and 'Tiflawn' receiving Banvel D at ½ pound ai/A without oil were not significantly different from those receiving the same rate with oil (Table 2). Prometryne, at 2 pounds ai/A, was significantly more toxic to 'Ormond,' 'Tifgreen' and 'Tiflawn' bermudagrasses when compared to checks. Reducing the rate of prometryne to 1 pound ai/A and adding 2 gpa oil significantly reduced toxicity when compared to 2 pounds ai/A without oil. Plots of 'Ormond' and 'Tifgreen' receiving 1 pound ai/A of prometryne were damaged significantly when compared to checks. 'Ormond' and 'Tifgreen' plots receiving atrazine at rate of 2 pounds ai/A were damaged significantly when compared to checks. Reducing the rate of atrazine to 1 pound ai/A and adding oil resulted in signifiantly less damage to 'Ormond' and significantly more damage to 'Tifgreen' and 'Tiflawn.'

DSMA when applied to 'Ormond,' 'Tifgreen' and 'Tiflawn' at rate of 6 pounds ai/A produced no toxic effects (Table 2). Reducing the rates of DSMA to 3 and 1 pounds ai/A and adding 2 gpa of oil resulted in no increased toxicity.

Spraying MSMA at 6 pounds ai/A to

TABLE 2. TOLERANCE RATINGS[1] OF BERMUDAGRASS SPRIGS AND SOD AFTER TREATMENT WITH VARIOUS HERBICIDES ALONE AND IN COMBINATION WITH OIL

TREAT. NO.	TREATMENTS	RATE OF: HERB. #ai/A	OIL gpa	GRASS 'Ormond' Sprigs	'Ormond' Sod	Tifgreen Sprigs	Tifgreen Sod	Tiflawn Sprigs	Tiflawn Sod
1.	Banvel D	½	0	9.0	9.0	8.3	8.3	8.3	8.7
2.	Banvel D + Oil	½	2	8.7	9.0	7.3	8.3	7.0	8.3
3.	Prometryne	2	0	5.7	6.3	3.0	7.3	3.0	8.0
4.	Prometryne + Oil	1	2	7.3	8.3	4.0	8.0	4.0	8.7
5.	Atrazine	2	0	6.7	8.3	6.7	8.3	7.0	8.7
6.	Atrazine + Oil	1	2	6.0	9.0	3.0	7.3	4.5	7.3
7.	DSMA	6	0	9.0	9.0	9.0	9.0	9.0	9.0
8.	DSMA + Oil	3	2	9.0	8.7	8.7	8.7	8.3	9.0
9.	DSMA + Oil	1	2	9.0	9.0	8.7	9.0	9.0	9.0
10.	MSMA	6	0	9.0	8.7	9.0	9.0	7.7	8.0
11.	MSMA + Oil	3	2	8.3	8.0	8.7	8.3	7.7	7.7
12.	MSMA + Oil	1	2	8.0	9.0	8.7	9.0	9.0	9.0
13.	MSMA + 2,4-D	4+½	0	7.7	9.0	8.0	8.7	8.0	9.0
14.	MSMA + 2,4-D + Oil	1+½	2	9.0	9.0	7.2	8.3	8.7	9.0
15.	Amchem 63-303	8	0	7.7	8.7	8.3	8.3	6.7	8.3
16.	Amchem 63-303 + Oil	4	2	8.7	9.0	8.7	8.7	7.3	9.0
17.	Amchem 63-303 + Oil	1	2	8.0	9.0	9.0	8.3	8.7	9.0
18.	Check (Oil Alone)	-	-	9.0	9.0	9.0	9.0	9.0	9.0

LSD	.05	.01
Between treatments	0.7	1.3

[1]Rating scale - 9 = No damage to sod or sprigs to 1 = Complete kill

'Ormond' and 'Tifgreen' resulted in no significant increased toxicity; however, the same rate produced a significant increase in toxicity symptoms to 'Tiflawn' (Table 2). Reducing the rate of MSMA to 3 pounds ai/A and adding 2 gpa oil resulted in a significant increased toxicity to 'Ormond' and 'Tifgreen' and no significant change on 'Tiflawn' when compared to 2 pounds ai/A without oil. Spraying a mixture of MSMA at the rate of 1 pound ai/A with 2,4-D at the rate of ½ pound ai/A on 'Tifgreen' resulted in a significant increase in damage that did not occur on 'Ormond' or 'Tiflawn.' Amchem 63-303 applied to 'Tifgreen' and 'Tiflawn' at the rate of 8 pounds ai/A produced a significant increase in toxicity when compared to checks (Table 2). All lower rates of Amchem 63-303 with oil produced no toxic effects to 'Ormond,' 'Tifgreen' or 'Tiflawn' bermuda (except that 1 pound ai/A rate plus oil produced a significant increase in toxicity when compared to the checks), (Table 2).

TABLE 3. TOLERANCE RATINGS[1] OF CENTIPEDEGRASS SEEDLINGS, SPRIGS AND SOD AFTER TREATMENT WITH VARIOUS HERBICIDES ALONE AND IN COMBINATION WITH OIL

TREAT. NO.	TREATMENTS	RATE OF: HERB. #ai/A	RATE OF: OIL gpa	CENTIPEDEGRASS SEEDLINGS	CENTIPEDEGRASS SPRIGS	SOD
1.	Banvel D	½	0	7.7	7.7	9.0
2.	Banvel D + Oil	½	2	1.3	5.0	9.0
3.	Prometryne	2	0	1.3	2.7	4.7
4.	Prometryne + Oil	1	2	1.0	2.3	3.7
5.	Atrazine	2	0	7.7	7.7	8.3
6.	Atrazine + Oil	1	2	1.0	5.0	8.0
7.	DSMA	6	0	1.0	1.3	2.3
8.	DSMA + Oil	3	2	1.7	3.0	2.0
9.	DSMA + Oil	1	2	2.3	4.3	3.7
10.	MSMA	6	0	1.0	1.0	1.0
11.	MSMA + Oil	3	2	3.3	1.0	1.0
12.	MSMA + Oil	1	2	2.0	3.0	3.7
13.	MSMA + 2,4-D	4+½	0	1.0	1.0	2.3
14.	MSMA + 2,4-D + Oil	1+½	2	1.0	2.3	2.3
15.	Amchem 63-303	8	0	1.0	2.7	3.3
16.	Amchem 63-303 + Oil	4	2	1.3	3.7	4.7
17.	Amchem 63-303 + Oil	1	2	6.3	6.7	7.3
18.	Check (Oil Alone)	-	-	9.0	9.0	9.0

LSD	.05	.01
Between treatments	1.3	1.8

[1]Rating scale - 9 = No damage to sod or seedlings to 1 = Complete kill

Centipedegrasses—Banvel D at rate of ½ pound ai/A with or without oil applied to centipede produced no toxicity when compared to checks (Table 3). Atrazine, when applied to centipede at the rate of 2 pounds ai/A without oil and 1 pound ai/A with oil, produced no significant increase in toxicity. All other herbicide treatments produced a highly significant increase in toxicity symptoms on centipedegrass.

DSMA, MSMA and Amchem 63-303 when applied at the low rate of 1 pound ai/A with 2 gpa of oil resulted in significantly less toxicity to centipede (Table 3).

St. Augustinegrasses—Two pounds ai/A atrazine and Amchem 63-303 at the rate of 1 pound ai/A plus oil were the only treatments that did not produce a significant increase in toxicity to St. Augustine (Table 4). Reducing rate of atrazine to 1 pound ai/A, adding oil and spraying on St. Augustine resulted in a significant increase in toxicity. One pound ai/A of both DSMA and MSMA plus oil resulted in significantly less damage than higher rates with or without oil (Table 4). Reducing the rate of Amchem 63-303 to 4 and 1 pounds ai/A and adding oil resulted in a significant reduction in toxicitiy symptoms of St. Augustine sod (Table 4).

Zoysiagrasses—Banvel D at the rate of ½ pound ai/A with or without oil produced no

TABLE 4. TOLERANCE RATINGS[1] OF ST. AUGUSTINEGRASS SPRIGS AND SOD AFTER TREATMENT WITH VARIOUS HERBICIDES ALONE AND IN COMBINATION WITH OIL

TREAT. NO.	TREATMENTS	RATE OF: HERB. #ai/A	OIL gpa	ST. AUGUSTINEGRASS Sprigs	Sod
1.	Banvel D	½	0	5.0	5.3
2.	Banvel D + Oil	½	2	4.5	5.3
3.	Prometryne	2	0	4.2	4.3
4.	Prometryne + Oil	1	2	4.0	5.3
5.	Atrazine	2	0	8.3	8.3
6.	Atrazine + Oil	1	2	4.0	7.0
7.	DSMA	6	0	1.0	4.3
8.	DSMA + Oil	3	2	3.0	4.3
9.	DSMA + Oil	1	2	7.0	6.3
10.	MSMA	6	0	1.0	2.0
11.	MSMA + Oil	3	2	1.0	1.7
12.	MSMA + Oil	1	2	5.0	5.7
13.	MSMA + 2,4-D	4+½	0	2.0	6.3
14.	MSMA + 2,4-D + Oil	1+½	2	3.7	4.3
15.	Amchem 63-303	8	0	5.7	5.3
16.	Amchem 63-303 + Oil	4	2	5.3	7.7
17.	Amchem 63-303 + Oil	1	2	4.3	8.0
18.	Check (Oil Alone)	-	-	9.0	9.0
LSD		.05	.05		
	Between treatments	1.1	1.7		

[1]Rating scale - 9 = No damage to sod or sprigs to 1 = Complete kill

toxic effects to either 'Emerald' or 'Meyer" zoysia sod (Table 5). Atrazine at 2 pounds ai/A without oil and 1 pound ai/A with oil was not toxic to either 'Emerald' or 'Meyer' zoysia sod. Both 'Emerald' and 'Meyer' were tolerant to DSMA at rates of 6 pounds ai/A without oil and 3-and 1-pound ai/A with oil. However, prometryne at 2 pounds ai/A was very toxic to both 'Emerald' and 'Meyer' (Table 5). The one pound ai/A rate of prometryne with oil was significantly less toxic to 'Emerald' sod than the 2 pounds ai/A without oil; however, this effect was not found on 'Meyer' sod. MSMA at 6 pounds ai/A was significantly more toxic to both 'Emerald' and 'Meyer' than the same rate of DSMA. Reducing the rate of MSMA to 3 pounds ai/A and adding oil resulted in a very highly significant increase in toxicity ratings to 'Emerald' and 'Meyer' sod; however, the 1 pound ai/A rate plus oil was not toxic to either (Table 5). The one pound ai/A rate of MSMA plus 2,4-D at ½ pound ai/A plus oil treatment was significantly less toxic to 'Emerald' or 'Meyer' zoysia sod than 4 pounds ai/A of MSMA plus ½ pound ai/A 2,4-D. All rates of Amchem's 63-303 were highly toxic to 'Emerald' sod and all rates except the one pound ai/A rate with oil were highly toxic on 'Meyer' sod.

TABLE 5. TOLERANCE RATINGS[1] OF ZOYSIAGRASS SPRIGS AND SOD AFTER TREATMENT WITH VARIOUS HERBICIDES ALONE AND IN COMBINATION WITH OIL

TREAT. NO.	TREATMENTS	RATE OF: HERB. #ai/A	RATE OF: OIL gpa	ZOYSIAGRASSES: Emerald Sprigs	Emerald Sod	Meyer Sprigs	Meyer Sod
1.	Banvel D	½	0	9.0	8.7	7.7	8.7
2.	Banvel D + Oil	½	2	6.0	8.7	8.0	9.0
3.	Prometryne	2	0	4.9	4.7	6.7	4.7
4.	Prometryne + Oil	1	2	3.3	6.3	3.7	5.0
5.	Atrazine	2	0	8.3	8.7	8.3	9.0
6.	Atrazine + Oil	1	2	4.7	9.0	8.3	8.3
7.	DSMA	6	0	9.0	9.0	8.3	9.0
8.	DSMA + Oil	3	2	8.3	9.0	7.7	8.7
9.	DSMA + Oil	1	2	9.0	9.0	8.7	8.7
10.	MSMA	6	0	8.3	8.0	8.7	8.0
11.	MSMA + Oil	3	2	6.3	6.0	7.7	6.7
12.	MSMA + Oil	1	2	8.3	9.0	5.3	8.7
13.	MSMA + 2,4-D	4+½	0	6.8	7.7	9.0	7.7
14.	MSMA + 2,4-D + Oil	1+½	2	7.0	9.0	8.0	8.3
15.	Amchem 63-303	8	0	3.3	3.3	3.0	4.3
16.	Amchem 63-303 + Oil	4	2	3.7	5.0	5.7	6.0
17.	Amchem 63-303 + Oil	1	2	8.3	6.3	8.3	8.3
18.	Check (Oil Alone)	-	-	9.0	9.0	9.0	9.0

LSD	.05	.01
Between treatments	.8	1.2

[1]Rating scale - 9 = No damage to sprigs or sod to 1 = Complete kill

Tolereance of Seedlings and Sprigs to Herbicides

Bahiagrasses—Seedlings of both 'Argentine' and 'Pensacola' bahia grasses were severely damaged by all rates of herbicides tested with or without oil (Table 1). The increased damage was very highly significant, and no herbicides tested was found safe for use on young seedlings of either 'Argentine' or 'Pensacola' bahia.

Bermudagrasses—Newly established sprigs of 'Ormond' bermudagrass were tolerant of ½ pound ai/A rate of Banvel D, with and without oil (Table 2). However, both 'Tifgreen' and 'Tiflawn' sprigs were significantly damaged by Banvel D at ½ pound ai/A without oil, and the same rate with oil resulted in an additional significant increase in toxicity to both 'Tifgreen' and 'Tiflawn.' Prometryne at 2 pound ai/A rate was very toxic to sprigs of the three bermudas. Reducing the rate of prometryne to 1 pound ai/A and adding oil resulted in a very highly significant reduction in toxicity to 'Ormond' and significant reductions in toxicity to both 'Tifgreen' and 'Tiflawn.'

The application of atrazine at the rate of 2 pounds ai/A resulted in a very significant increase in toxicity to sprigs of 'Ormond,' 'Tifgreen' and 'Tiflawn' bermudagrass (Table 2). Reducing the rate of atrazine to 1 pound ai/A and adding oil resulted in significantly increased toxicity to 'Ormond' and even more damage to 'Tifgreen' and 'Tiflawn' sprigs.

Three pounds ai/A DSMA plus oil resulted in a significant increase in toxicity symptoms on 'Tiflawn' sprigs; however the 6 pound ai/A rate without oil and 1 pound ai/A rate with oil was not toxic to sprigs of 'Ormond' and 'Tifgreen' (Table 2). MSMA at 6 pounds ai/A rate was found to be more toxic to the 'Tiflawn' sprigs than DSMA. Reducing the rates of MSMA to 3 and 1 pounds ai/A and adding oil significantly increased toxicity symptoms on 'Ormond' sprigs and had no effects on 'Tifgreen' sprigs. One pound of MSMA plus oil resulted in significantly less damage to sprigs of 'Tiflawn' when compared to higher rates. MSMA at rates of 4 pounds ai/A plus 2,4-D at ½ pound ai/A plus oil resulted in significant increases in damage to 'Ormond,' 'Tifgreen' and 'Tiflawn' sprigs. Reducing the rate of MSMA to 1 pound ai/A and using ½ pound of 2,4-D plus oil resulted in no significant damage to either 'Ormond' or 'Tiflawn' but a very highly significant increase in toxicity to 'Tifgreen' (Table 2).

Applications of Amchem 63-303 at 8 pounds ai/A resulted in significant increases in toxicity ratings of 'Tifgreen' sprigs and a very highly significant increase in toxicity to sprigs of 'Ormond' and 'Tiflawn' (Table 2). Lower rates of Amchem 63-303 with oil, when compared to the high rate, resulted in significantly less damage to 'Tifgreen' and 'Tiflawn' but not to 'Ormond.'

Centipedegrasses—Seedling and sprigs of centipedegrass were significantly damaged by all treatments (Table 3). Most treatments produced a highly significant increase in damage to both seedlings and sprigs. Banvel D at ½ pound ai/A without oil, atrazine at 2 pounds ai/A and Amchem 63-303 at 1 pound ai/A with oil produced significantly less damage to sprigs and seedlings of centipedegrass than any other treatments (Table 3).

St. Augustinegrasses—Sprigs of St. Augustinegrass were severely damaged by all treatments except atrazine at the rate of 2 pounds ai/A (Table 4). Reducing the rate of atrazine to 1 pound ai/A and adding oil resulted in highly significant increased toxicity to St. Augustine sprigs. Atrazine, alone, at 2 pounds ai/A is the only herbicide tested that can be safely used on St. Augustine sprigs.

Zoysiagrasses—'Emerald' zoysia sprigs were tolerant to Banvel D at ½ pound ai/A, atrazine at 2 pounds ai/A, DSMA at 6 pounds ai/A, DSMA at 3 and 1 pounds ai/A plus oil and MSMA at 6 pounds ai/A without oil and 1 pound ai/A with oil (Table 5). Banvel D sprayed at ½ pound ai/A with oil resulted in a highly significant increase in toxicity when compared to the same rate without oil or the checks.

Prometryne at rate of 2 pounds ai/A was very toxic to sprigs of both 'Emerald' or 'Meyer' zoysia. Reducing the rate of prometryne to 1 pound ai/A and adding oil increased the toxicity significantly.

Atrazine applied at 1 pound ai/A with oil resulted in a highly significant increase in toxicity to 'Emerald' sprigs but none to 'Meyer' sprigs. DSMA at rates of 6 pounds ai/A without oil and 3 and 1 pounds ai/A with oil did not cause damage to 'Emerald' zoysia sprigs. The same was true for 'Meyer' sprigs except for the 3 pounds ai/A rate plus oil which significantly increased toxicity symptoms.

'Emerald' and 'Meyer' zoysia sprigs were

tolerant of MSMA at rate of 6 pounds ai/A; however, when the rate of MSMA was reduced to 3 pounds ai/A and oil was added, significantly more toxicity to sprigs resulted on both zoysia grasses. One pound of MSMA plus oil was not toxic to 'Emerald' but was very toxic to 'Meyer' zoysia sprigs. Applications of MSMA, at rates of 4 pounds ai/A plus 2,4-D at ½ pound ai/A without oil and 1 pound ai/A MSMA with ½ pound ai/A 2,4-D plus oil, resulted in highly significant increases in toxicity ratings on sprigs of 'Emerald' zoysia. Only the 1 pound ai/A rate of MSMA plus ½ pound ai/A 2,4-D plus oil treatment resulted in a significant increase in toxicity to 'Meyer' sprigs.

Amchem 63-303 was very toxic to both grasses except at the 1 pound ai/A rate with oil (Table 5).

Preemergence Weed Control Evaluations

Banvel D at the ½ pound ai/rate was found to be a very poor preemergence herbicide; however, when 2 gpa of oil was added, preemergence weed control activity was significantly increased (Table 6). Banvel D at ½ pound ai/A with or without oil was found to be toxic only to St. Augustine sod (Tables 1-5). Even after 6 months the added preemergence weed control effect from the oil was significantly better than Banvel D alone or the checks (Table 6).

Prometryne and atrazine at 2 pounds ai/A resulted in excellent preemergence weed control; however, reducing the rate of either to 1 pound ai/A and adding oil resulted in significantly better preemergence weed control than 2 pounds ai/A without oil (Table 6). The increased pre-

Table 6. PRE-EMERGENCE WEED CONTROL RATINGS[1] AFTER TREATMENT WITH VARIOUS HERBICIDES ALONE AND IN COMBINATION WITH OIL

TREAT. NO.	TREATMENTS	RATE OF: Herb. #ai/A	RATE OF: Oil gpa	TREATMENT MEANS After: 1 Month	TREATMENT MEANS After: 6 Months
1.	Banvel D	½	0	7.4	8.8
2.	Banvel D + Oil	½	2	2.7	5.7
3.	Prometryne	2	0	1.8	2.9
4.	Prometryne + Oil	1	2	1.1	2.8
5.	Atrazine	2	0	1.5	2.1
6.	Atrazine + Oil	1	2	1.0	1.6
7.	DSMA	6	0	6.1	8.4
8.	DSMA + Oil	3	2	5.2	9.0
9.	DSMA + Oil	1	2	7.1	9.0
10.	MSMA	6	0	4.9	8.4
11.	MSMA + Oil	3	2	5.1	8.5
12.	MSMA + Oil	1	2	7.6	8.8
13.	MSMA + 2,4-D	4+½	0	1.6	5.7
14.	MSMA + 2,4-D + Oil	1+½	2	2.2	6.8
15.	Amchem 63-303	8	0	1.3	3.3
16.	Amchem 63-303 + Oil	4	2	3.2	5.2
17.	Amchem 63-303 + Oil	1	2	5.1	8.3
18.	Check (Oil Alone)	–	–	9.0	9.0
LSD:				.05 .01	.05 .01
	Between treatment means			.4 .7	.6 1.1

[1]Rating scale - 9 = No control of emerging weeds to 1= Complete kill

TABLE 7. POST-EMERGENCE CONTROL RATINGS[1] OF YOUNG AND WELL ESTABLISHED WEEDS WITH VARIOUS HERBICIDES ALONE AND IN COMBINATION WITH OIL

TREAT. NO.	TREATMENTS	RATE OF: HERB. #ai/A	RATE OF: OIL gpa	YOUNG ESTABLISHED GRASS AND BROADLEAF WEEDS-5 WEEKS OLD		WELL ESTABLISHED GRASS AND BROADLEAF WEEDS-6 MONTHS OLD
1.	Banvel D	½	0	8.4		8.5
2.	Banvel D + Oil	½	2	6.0		7.3
3.	Prometryne	2	0	1.2		3.8
4.	Prometryne + Oil	1	2	1.5		2.2
5.	Atrazine	2	0	2.3		5.9
6.	Atrazine + Oil	1	2	1.5		3.9
7.	DSMA	6	0	5.1		5.1
8.	DSMA + Oil	3	2	4.4		5.5
9.	DSMA + Oil	1	2	7.3		6.7
10.	MSMA	6	0	2.1		1.9
11.	MSMA + Oil	3	2	2.4		2.1
12.	MSMA + Oil	1	2	6.5		6.7
13.	MSMA + 2,4-D	4+½	0	1.8		1.5
14.	MSMA + 2,4-D + Oil	1+½	2	3.9		3.2
15.	Amchem 63-303	8	0	2.0		2.5
16.	Amchem 63-303 + Oil	4	2	6.6		6.3
17.	Amchem 63-303 + Oil	1	2	8.0		8.1
18.	Check (Oil Alone)	-	-	9.0		9.0
LSD		.05	.01	.05	.01	
	Between treatments	.3	.5	.5	.9	

[1]Rating scale - 9 = No control of established weeds to 1 = Complete kill

emergence weed control activity due to the oil did not hold after 6 months, but the 1 pound ai/A rates with oil were equal to the 2 pound ai/A rate without oil.

DSMA and MSMA are not used as preemergence herbicides; however, both herbicides at all rates used (with and without oil) resulted in significant increases in preemergence weed control activity when compared to the checks (Table 6). Reducing the rate of DSMA to 3 pounds ai/A and adding oil resulted in a highly significant increased preemergence weed control activity. The 1 pound ai/A rate produced significantly less preemergence activity. MSMA at 6 pounds ai/A produced significantly better preemergence weed control than 3 and 1 pounds ai/A with oil. A significant increase in preemergence activitiy was found where 6 pounds ai/A of both DSMA and MSMA were applied. Reduced rates of both herbicides when mixed with oil resulted in no preemergence weed control after 6 months (Table 6).

Treatments 13 and 14 (Table 6) produced interesting results. Premergence weed control ratings of the 6 pounds ai/A MSMA treatment were 4.9. Also, 2,4-D is not considered to be a preemergence herbicide; however, when a mixture of MSMA and 2,4-D was sprayed on clean cultivated plots at the rates of 4 and 1 pounds ai/A, respectively, a very significant increase in preemergence weed control was found. The rating was 1.6 (Table 6) which is equal to the 2 pound ai/A rate of atrazine or prometryne. Maintaining the 2,4-D at the same rate but reducing the MSMA to 1 pound ai/A and adding oil resulted in a significant decrease in preemergence weed control when compared to the 4 pound ai/A MSMA plus ½ pound ai/A 2,4-D rate. This reduced MSMA rate plus oil when compared to the check resulted in a very significan increase in preemergence weed control.

Amchem 63-303 at the rate of 8 pounds ai/A resulted in excellent preemergence weed control. Reduced rates of 4 and 1 pounds ai/A plus oil resulted in significantly less preemergence weed control.

Postemergence Weed Control Evaluations

Banvel D at ½ pound ai/A was found to be a very poor postemergence herbicide (Table 7). Mixing the same rate of Banvel D and adding oil resulted in a highly signifificant increase in postemergence weed control in both young and well-established weeds.

Prometryne at 2 pounds ai/A rate resulted in excellent postemergence weed control. Reducing the rate of prometryne to 1 pound ai/A and adding oil resulted in a significant decrease in postemergence control of young weeds but a very highly significant increase in control of well-established weeds (Table 7).

Atrazine at 2 pounds ai/A resulted in excellent postemergence weed control of young weeds. When the rate of atrazine was reduced to 1 pound ai/A and oil was added, a very significant increase in postemergence control of both young and well-established weeds resulted (Table 7).

DSMA at 6 pounds ai/A gave poor postemergence weed control. This is understandable because the recommended practice is for 3 to 5 applications 5 days apart. Reduction of the rate of DSMA to 3 pounds ai/A and adding oil resulted in highly significant increase in postemergence weed control of young weeds and equal control of well-established weeds. DSMA at rate of 1 pound ai/A plus oil resulted in a highly significant reduction of control of young and well-established weeds.

MSMA at the rate of 6 pounds ai/A resulted in a highly significant increase in postemergence weed control of both young and well-established weeds when compared to DSMA at the same rate (Table 7). MSMA at 3 pounds ai/A plus oil resulted in significant less control of young and well-established weeds when compared to 6 pounds ai/A of DSMA. The 3 pounds ai/A rate of MSMA plus oil was *significantly* better than 6 pounds ai/A DSMA without oil (Table 7). One pound ai/A MSMA plus oil resulted in very poor postemergence weed control.

The herbicide blend of MSMA and 2,4-D when applied at rates of 4 and 1 pounds ai/A, respectively, resulted in excellent postemergence weed control of both young and well-established weeds. This was the best treatment for well-established weed control. A four-fold reduction in rate of MSMA to 1 pound ai/A and applying it with ½ pound of ai/A of 2,4-D plus oil resulted in a highly significant decrease in postemergence weed control.

Amchem 63-303 used at the rate of 8 pounds ai/A resulted in excellent postemergence weed control. Rates of 3 and 1 pounds ai/A plus oil were significantly poorer.

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