1993 TURF WEED CONTROL AND MANAGEMENT UPDATE

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Research conducted in 1993 covered a broad array of subjects from pesticide and nutrient fate to bentgrass breeding and genetics. Topics to be covered in this article include pesticide leaching, PGR's for growth regulation of annual bluegrass (*Poa annua*) and creeping bentgrass (*Agrostis palustris*), and Basamid® for soil sterilization to control *Poa annua* seeds. Other areas of research conducted during 1993 are reported in other articles in this volume.

Contamination of groundwater by pesticides has been one of the critical issues in agriculture during the past decade. The turfgrass industry has also felt the considerable heat generated by this topic. This research was initiated in 1991 with a grant from the United States Golf Association Green Section Research Committee. Four large, non-weighing lysimeters were constructed in 1990-91 and used to test for the leaching of pesticides. Eight pesticides were applied during 1991-2 according to the schedule outlined in Table 1.

Table 1. Application information and environmental data for pesticides applied to the lysimeters.

PESTICIDE	APP RATE (kg/ha)	APP DATE	SOIL $T_{1/2}$ (days)	WATER SOL (mg/L)	K_{OC}
isazophos	2.24	8/12/91	34	69	100
2,4-D	1.14	9/17/91	10	890	20
dicamba	0.12	9/17/91	14	400,000	2
chlorothalonil*	9.56	8/21/91	30	0.6	1380
propiconazole	2 oz prod/M	6/18/92	110	110	650
fenarimol	0.76	5/3/92	360	14	600
triadimefon	1.53	7/21/92	26	71.5	300
metalaxyl*	1.53	8/5/92	70	8400	50

* chlorothalonil was also applied to lysimeters 3 and 4 on 7/21,8/5,8/20, and 9/4/92. Metalaxyl was applied also to lysimeters 3 and 4 on 7/21, 8/13, and 9/4/92.

Pesticide applications were made with a standard research plot sprayer using flat fan nozzles. Pesticides were chosen based upon use patterns in turf and upon the chemical properties of the pesticides such that some, such as 2,4-D, dicamba, and metalaxyl, were considered quite likely to reach groundwater while others, e.g. chlorothalonil and fenarimol, were considered very unlikely to reach groundwater. Five of the eight pesticides chosen for this study were fungicides since they represent the most frequently used pesticides in turf. Lysimeter drainage was collected as indicated by the flow rate of each lysimeter. Typically, samples were collected every two weeks unless lysimeter flow was high enough to warrant more frequent sampling. All water samples were stored at 2 C until analysis by gas chromatography.

Results have so far shown very little movement to the bottom of the lysimeter of any of the applied pesticides. Of the eight pesticides applied, five have not yet been detected. Only dicamba and triadimefon have been detected with some frequency as 2,4-D has given only one detection since application. Levels of dicamba and triadimefon in the drainage water are shown in figures 1 and 2. Dicamba (Figure 1) was applied in mid-September and was first detected in November with subsequent detections in March and April. The largest detection was in late November when 3.1 PPM was detected in the leachate from one of the lysimeters. Further testing has not detected any other residues of dicamba.

Triadimefon (Figure 2) was detected on several occasions at much lower levels than dicamba. Triadimefon was applied on 7/21/92 and the highest level of detection was 31 PPB on 10/15/92. The leaching of triadimefon was surprising in light of its physico-chemical properties (table 1) which would lead one to suspect that triadimefon is not very mobile in soils or at the very least propiconazole and metalaxyl should be seen more frequently and at higher concentrations than triadimefon. That this does not occur requires further study and model refinement.

When considering the overall picture so far obtained from the pesticide leaching data, the overall tenor of the results are quite positive. Five out of eight pesticides have not been detected. Both 2,4-D and dicamba are known to be mobile in soils and there is no surprise in finding them in the lysimeter effluent although we expected to find higher levels and more frequent detections of 2,4-D. The finding of triadimefon is disturbing only in the light of our prediction that it would be the third most mobile of the five fungicides tested. Apparently the turfgrass system may drastically reduce the mobility of propiconazole and metalaxyl perhaps by rapid metabolism in the thatch layer.

Plant growth regulators (PGR's) have held considerable promise as a means to reduce the maintenance of turfgrasses. So far the promise has largely been unfulfilled. The introduction of a new PGR, Primo®, for use on fine turf and the recognition by the golf course industry of the value of PGR's for reduction in clipping volume has led to a resurgence of interest in these products. In 1993 a test was conducted to determine the relative growth suppression and influence on turf quality of Primo® on annual bluegrass and creeping bentgrass maintained at a 0.5" height of cut. Cutless®at 0.25 lbAI/A was included for comparison to the three rates of Primo® examined. The data (tables 2 &3) were somewhat compromised by the failure of an irrigation head which covered part of the bentgrass turf and caused growth to slow due to drought stress as well as the PGR. This is clear from the drop in clipping weights for the control plot from week 1 to week 2 (table 3). Primo® provides growth regulation comparable to that of Cutless® on creeping bentgrass. On annual bluegrass, Primo® seemed to cause less injury than did Cutless® and this may indicate that Primo® is not as effective in Poa conversion as is Cutless®. However, the clipping weight data would indicate that Primo® and Cutless® provide comparable growth suppression of annual bluegrass. Data on the effectiveness of PGR's for golf turf will continue to be an important area for future research.

One area of research that we are excited about is the use of Basamid for soil sterilization. Basamid® is a granular product that releases a gas upon hydrolysis by water. The gas will kill weed seeds, fungi, insects, nematodes, etc. The product is similar in action to methyl bromide, the most commonly used soil fumigant, which will soon be banned from future use. Basamid® is applied as a granular and after watering, can be covered with a tarp or incorporated by cultivation into the soil. This flexibility in application conditions is an advantage over methyl bromide which is applied as a gas and must be tarped immediately.

This investigation was designed to examine the effectiveness of Basamid® in controlling *Poa annua* seed in the soil. Basamid® has been labeled for use in a variety of situations but has never received much turf use in the US. The price of the product is high and that may have inhibited the development of the product. However, for use on golf course tees and greens where the acreage is small, Basamid® could be an effective product to eliminate the reservoir of *Poa annua* seed in the soil.

This experiment studied the effect of Basamid® incorporation method, Basamid® rate, and the effect of tarping on the control of *Poa annua* seed in the soil. Four rates of Basamid® , 0, 5,25, and 100 ounces of product/ 1000 ft^2, were used. Soil incorporation was achieved by either hand raking, light vertical mowing, or attempting to seal the gas in with a heavy application of a paper mulch. Twelve treatment combinations (4 rates X 3 application methods) were laid out in two separate blocks from which the *Poa annua* turf had been removed with a sod cutter. After the treatments were applied and watered in with 45 minutes of overhead irrigation, one block of 12 treatments was covered with a black plastic tarp while the other block of 12 treatments was left uncovered. After 11 days the tarp was removed and the entire plot area was lightly verticut to permit the escape of any remaining gas. A golf course cup cutter was used to remove 2 cores from each plot and the cores were sectioned into 0-1, 1-2, and 2-3 cm intervals. The soil from the same depth intervals were combined, air-dried, and lightly ground. A weighed portion of the air-dried soil was placed in the greenhouse as a 1/4" layer on top of sterilized soil. A mist system was used to keep the soil surface moist and P. annua seed that germinated in each container was counted until germination ceased. The data (Figures 3-5) are reported as the total amount of *Poa annua* seeds that germinated per depth interval.

As we should have foreseen, the tarped plots were compromised because of the nature of the treatments. The gas generated in the higher rates moved into surrounding plots causing better than expected control. The control plot in the tarped area had an average of only 2.6 seedlings while the control plot in the untarped area had 15.7 seedlings. In the tarped area the gas spread and thus these numbers are not very informative. It is evident from the data that even where the soil was not tarped, excellent control of *Poa annua* seedling was seen at the highest Basamid® rate. This study needs to be repeated with proper control of the tarping in order to determine the rate needed for control of *Poa annua* seeds. Data in Figure 5 yielded some interesting observations on the depth of viable *Poa annua* seeds in the soil. In the 2-3 cm zone (0.8-1.2 in) there was still 40 % of the viable seed found in the 0-1 cm zone. Remember that these zones were determined after the sod was removed and undoubtedly a large amount of *Poa annua* seed was removed in the sod layer also.

This technique holds promise for superintendents looking to reestablish greens and tees to bentgrass and who want to limit the amount of *Poa annua* invasion. *Poa annua* would have to recolonize the area after Basamid® treatment. Greens and tees can be readily tarped to improve the performance and reduce the rate of Basamid® used. Research to be conducted in 1994 will include methods of using Basamid® without tarping for control of *Poa annua* seed in fairway turf during a general course renovation.

Table 2. Turf quality and clipping yield for PGR's on annual bluegrass.

		TURF QUALITY 1-9				
TREATMENT	RATE	7 DAT	14 DAT	21 DAT	28 DAT	28 DAT Seedhead[1]
Primo 1 EC	0.0875	8	6.7	6.2	6.8	4.7
Primo 1 EC	0.175	8	6.7	7	6.3	6.3
Primo 1 EC	0.262	8	6.5	6.5	5.8	6.7
Cutless 50 WP	0.25	8	7.0	5	5.7	5.0
Control		8	7.3	7.2	7.0	2.0
LSD (P=0.05)		ND	0.7	1.3	0.7	3.7

[1] Visual rating of seedhead density with 0= no seedheads and 10= many seed

CLIPPING YIELDS (gm/4.6 m^2)

TREATMENT	RATE	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT	49 DAT
Primo 1 EC	0.0875	48.4	14.7	23.6	30.6	18.6	48	48.9
Primo 1 EC	0.175	41.1	12.5	22.2	21.6	15.6	45.4	49.2
Primo 1 EC	0.262	47.1	9.1	14.4	13.4	10.9	39.3	44.9
Cutless 50 WP	0.25	69.6	14.3	19.5	21.7	16.3	47.6	50.6
Control		77.6	37.3	37.6	59.9	33.1	65.7	61.6
LSD (P=0.05)		NS	12.3	8.7	8.4	8.2	NS	NS

Table 3. Turf quality and clipping yield for pgr's on creeping bentgrass.

		TURF QUALITY 1-9				
TREATMENT	RATE	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT
Primo 1 EC	0.0875	8.5	7.8	7.2	8.2	8.0
Primo 1 EC	0.175	8.5	7.0	6.2	8.2	8.2
Primo 1 EC	0.262	8.5	6.5	6.0	8.7	8.3
Cutless 50 WP	0.25	8.5	7.5	7.2	8.0	8.0
Control		8.5	8.0	7.8	7.5	7.7
LSD (P=0.05)		ND	0.7	0.9	0.6	NS

		CLIPPING YIELDS (gm/4.6 m^2)						
TREATMENT	RATE	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT	49 DAT
Primo 1 EC	0.0875	90.0	8.4	8.2	6.8	22.6	67.6	72.8
Primo 1 EC	0.175	95.4	8.3	9.0	4.4	15.5	79.1	85.3
Primo 1 EC	0.262	102	8.2	9.4	3.0	16.4	79.0	83.3
Cutless 50 WP	0.25	115.4	9.1	9.1	6.4	27.5	102.1	101.1

Control	113.2	21.0	17.5	16.3	39.6	102.5	101.3
LSD (P=0.05)	NS	6.8	3.3	4.0	12.2	NS	NS

Figure 1. Leaching of dicamba through monolith lysimeters

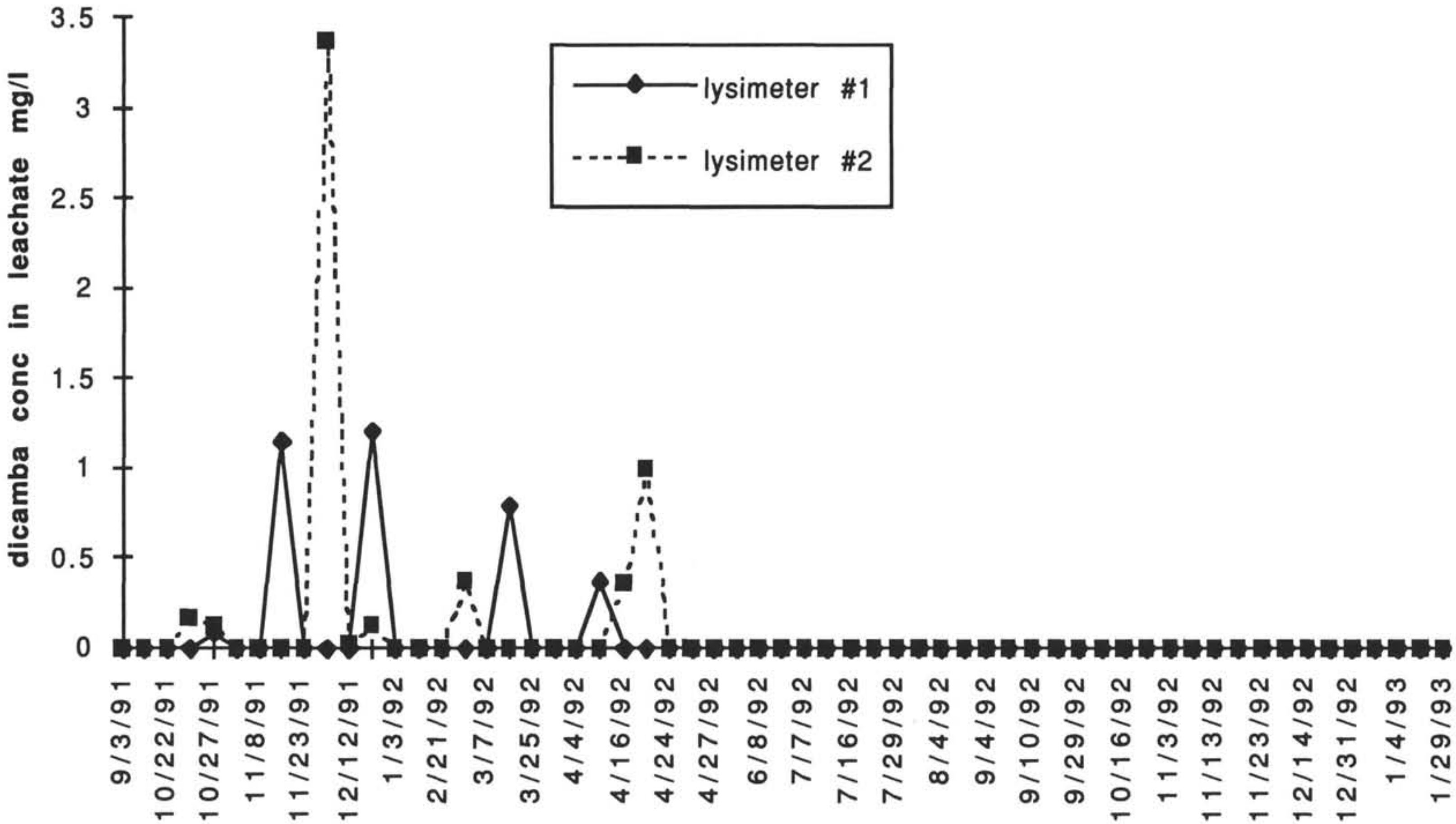

FIGURE 2. LEACHING OF TRIADIMEFON IN MONOLITH LYSIMETERS

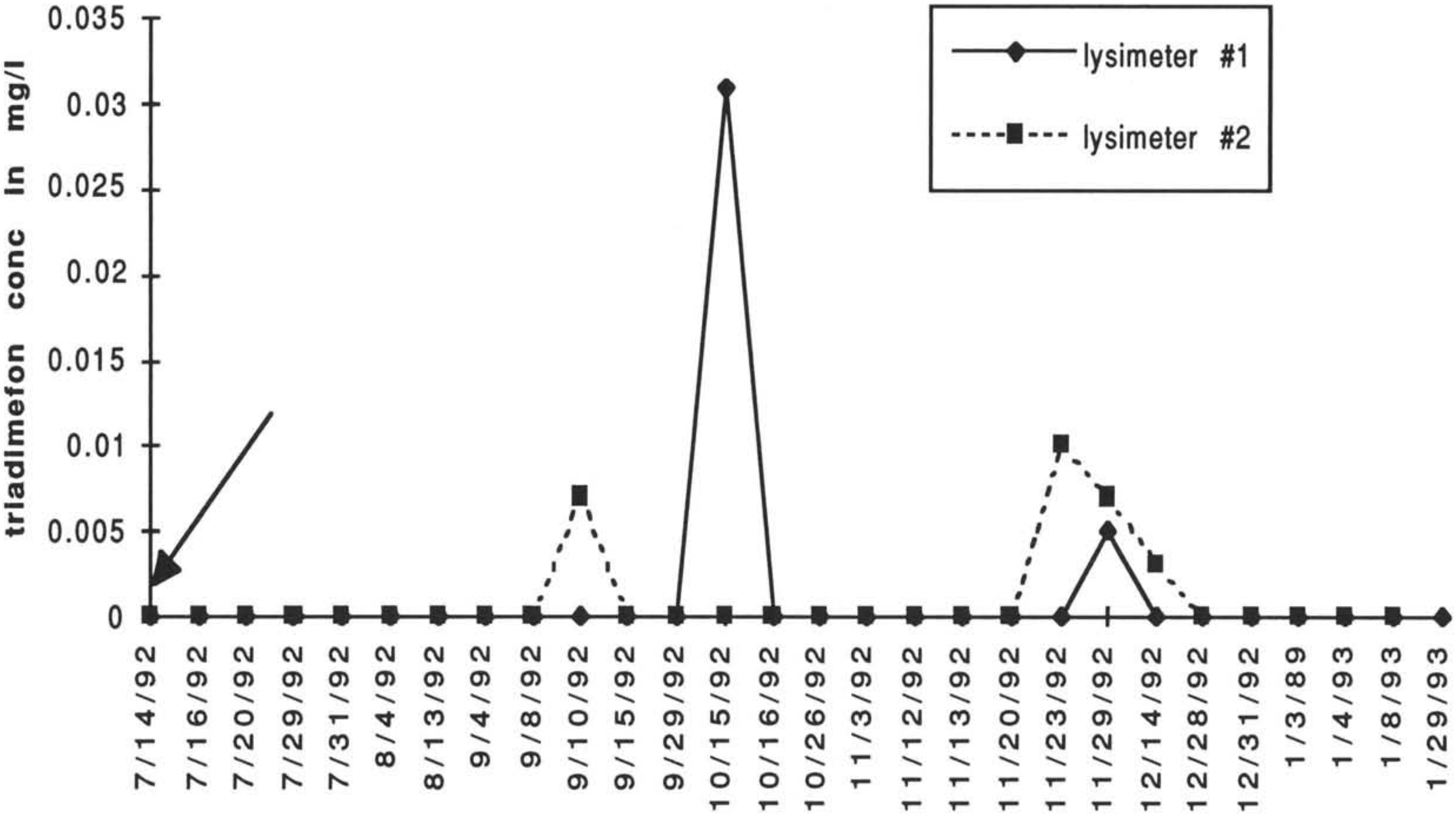

FIGURE 3. EFFECT OF BASAMID ON *POA ANNUA* GERMINATION

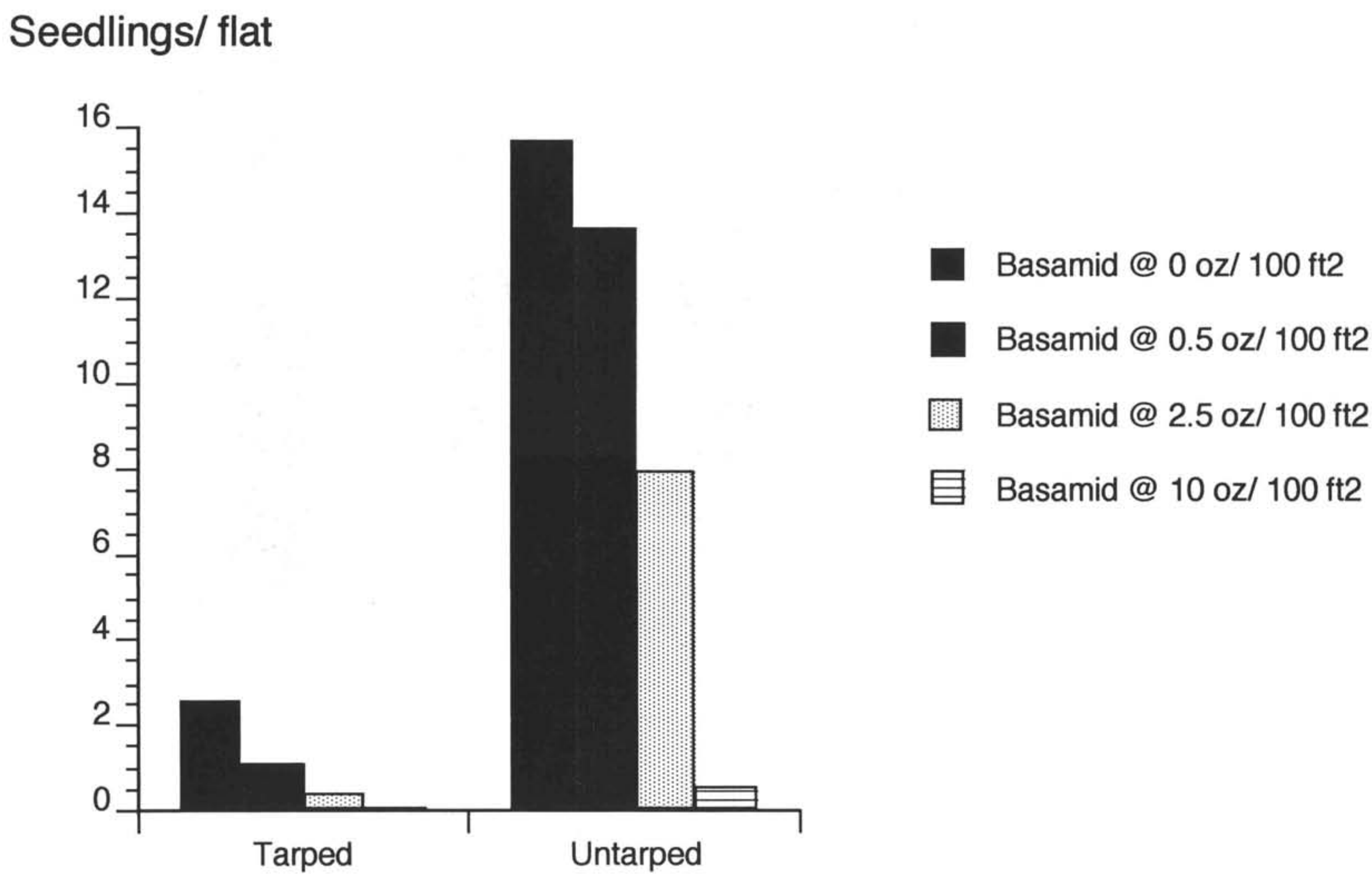

FIGURE 4. EFFECT OF INCORPORATION METHOD ON BASAMID ACTIVITY

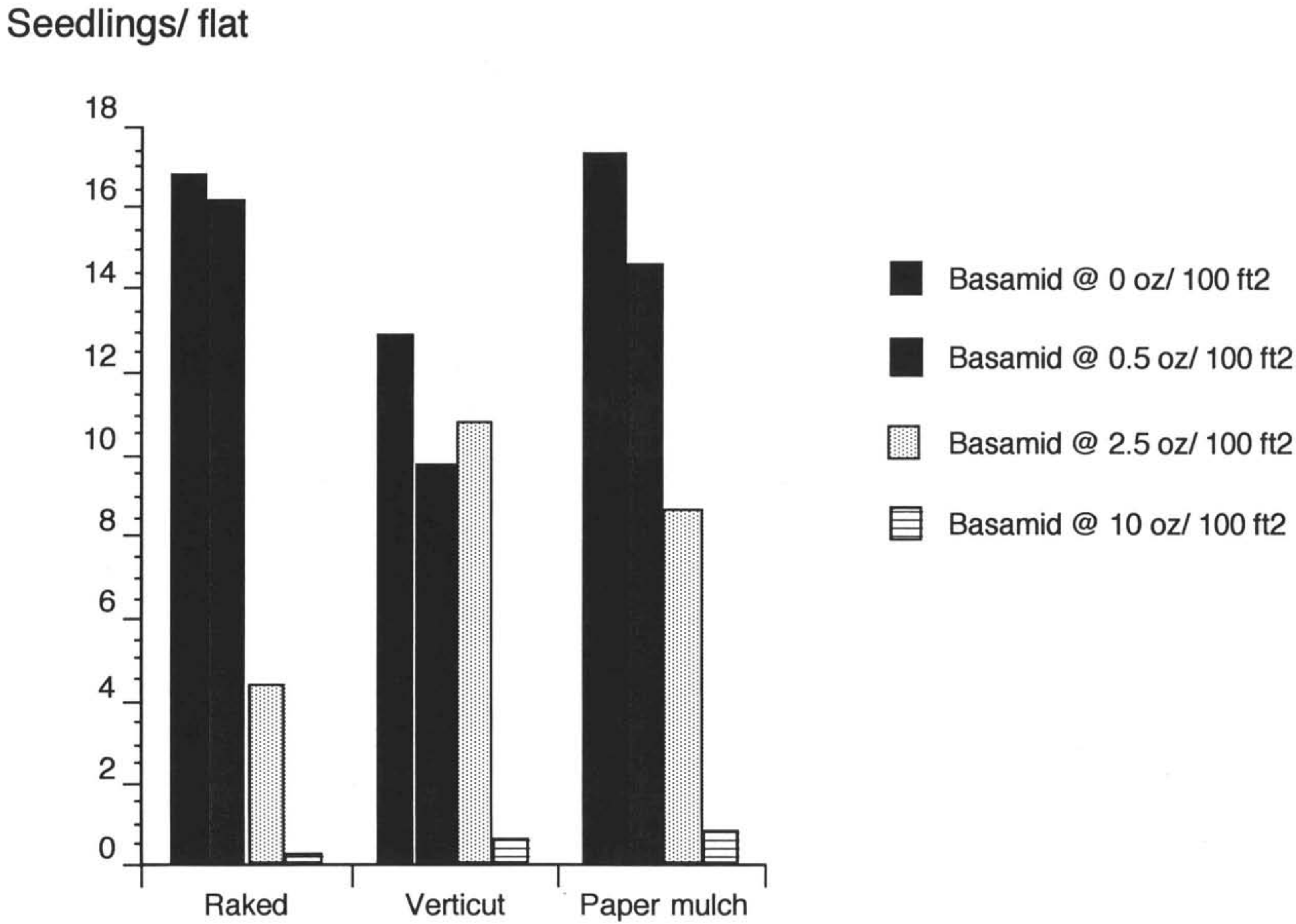

FIGURE 5. CONTROL OF POA ANNUA SEED BY DEPTH WITH BASAMID