J. Aquat. Plant Manage. 30: 48-49

NOTES

Inhibition of Hydrilla Tuber Formation by Bensulfuron Methyl

W. T. HALLER, A. M. FOX AND C. A. HANLON[1]

INTRODUCTION

Following successful herbicide treatment of hydrilla (*Hydrilla verticillata* (L.f.) Royle), regrowth generally originates from root crowns that survive the herbicide treatment, or from vegetative propagules (tubers and turions) protected from the treatment by being in or on the hydrosoil. Hydrilla regrowth, almost exclusively from tubers and turions, occurred the December following successful spring-early summer fluridone (1-methyl-3-phenyl-5-[3-(trifluoromethyl) phenyl]-4(1*H*)-pyridinone) treatments in the upper St. Johns (Haller et al. 1990) and Withlacoochee Rivers (unpublished Ms.). Dioecious hydrilla forms tubers in Florida under short day conditions (Sep-May) and a plant derived from a tuber can form a new tuber within 8 weeks after germination (Haller et al. 1976, Van 1989). Strategies for the long term management of hydrilla will likely include reducing hydrilla reproduction and reduction of the reservoir of reproductive propagules in the hydrosoil (Van and Steward 1990).

Bensulfuron methyl (Methyl 2-[[[[[(4,6 dimethoxypyrimidin-2- yl) amino] carbonyl] amino] sulfonyl] methyl] benzoate) is a sulfonylurea herbicide which inhibits the activity of acetolactate synthase and ultimately interferes with protein synthesis. Bensulfuron methyl was registered for use in rice in 1984 and has an experimental use permit (EUP) for evaluating growth regulation and herbicidal effects in aquatic habitats. In the mid 1980's, Anderson and Dechoretz (1988) evaluated bensulfuron methyl for the control of aquatic plants. They found that growth of *Potamogeton* spp. and hydrilla were reduced by bensulfuron methyl at concentrations of 5 to 10 ppb. In addition, they determined that split applications, 50 ppb applied two weeks apart, prevented hydrilla tuber production for a 6 week growth period.

The objective of this study was to evaluate the effects of bensulfuron methyl on seasonal tuber production by germinating tubers and regrowing root crowns, rapidly growing vegetative structures implicated in hydrilla regrowth following herbicidal treatments.

METHODS AND MATERIALS

Hydrilla root crowns were collected from the spring-fed Jumper Creek, in Sumter County, FL and tubers were collected from the hydrosoil of concrete culture tanks located at the Center for Aquatic Plants, Gainesville, FL.

Hydrilla stems and roots were pruned from the root crowns, leaving 2 to 4 cm stems and roots. Six root crowns were planted in 5 cm of commercial potting soil in plastic pans (34 cm long by 29 cm wide by 12 cm deep). Six pans of root crowns were planted in each of 12 (900 l) concrete tanks. Hydrilla tubers were collected, rinsed and allowed to sprout in tap water at room temperature. Fifteen sprouting tubers 2.5 to 5.0 cm in length were planted in pans (described above) and 6 pans were placed in each of the 12 concrete tanks containing the previously planted root crowns. Planting of root crowns (Sep 12) and tubers (Sep 19) was followed by bensulfuron methyl applications of 0, 5, 10, 15, 20, and 25 ppb a.i. (two tanks for each treatment concentration) on Sep 28. The water source for the tanks was unchlorinated well water (pH 6.7). The water volume in the tanks was maintained by regular additions of well water to compensate for evaporation.

On Jan 25 (4 months following treatment), the 2 tanks were temporarily drained and rinsed, three pans of root crown and three pans of tuber derived plants were removed from each of the 12 tanks and the tanks still containing 3 pans each of root crowns and tubers, were refilled with fresh well water. The soil in the pans was screened and the number of newly formed tubers was determined.

On Feb. 4, three pans of newly planted root crowns and newly germinated tubers were planted (as described above) in 6 of the 12 tanks. The six tanks containing 3 pans each of tubers and root crowns planted in September and newly planted tubers and root crowns were re-treated with bensulfuron methyl on Feb 8 at concentrations of 0, 5, 10, 15, 20 and 25 ppb a.i. (the remaining 6 tanks were not treated again). All pans were removed on June 3 (4 months after re-treatment and 8 months after initial September treatments) and newly formed tubers were enumerated.

The scheme outlined above permitted the following treatment and harvest schedules where individual pans were considered as replications: 1-plant and treat in September/harvest January, three root crown and three tuber pans from each of 12 tanks, N = 6 for each concentration and plant type; 2-plant and treat in September/harvest in June, N = 3 for each concentration and plant type; 3-plant

[1]University of Florida, Center for Aquatic Plants and Agronomy Department, 7922 NW 71st Street, Gainesville, FL 32606. Current address of Hanlon is S. Florida Water Management District, West Palm Beach, FL 33416. Received for publication October 27, 1991 and in revised form December 2, 1991.

TABLE 1. THE EFFECTS OF BENSULFURON METHYL ON TUBER PRODUCTION BY NEWLY PLANTED HYDRILLA ROOTCROWNS (RC) AND SPROUTING TUBERS (T). THE VALUES IN THE TABLE ARE THE NUMBER OF TUBERS FORMED PER PAN (0.1 m^2) FOLLOWED BY THE STANDARD DEVIATION IN PARENTHESES.

Concentration (ppb)	Treated: Sep Harvest: Jun		Treated: Sep and Feb Harvest: Jun		Treated: Sep Harvest: Jan		Treated: Feb Harvest: Jun	
	RC	T	RC	T	RC	T	RC	T
0	21(9)	13(5)	17(4)	9(2)	13(6)	3(2)	8(1)	4(2)
5	19(5)	10(5)	9(6)	<1	5(3)	<1	<1	0
10	9(3)	<1	<1	1(1)	<1	<1	3(2)	<1
15	33(16)	27(3)	0	0	1(2)	<1	0	<1
20	<1	0	1(1)	0	0	0	0	<1
25	1(2)	1(1)	0	0	0	0	0	<1

and treat in September/retreat in February/harvest in June, N = 3 for each concentration and plant type; and 4-plant and treat in February/harvest in June, N = 3 for each concentration and plant type.

RESULTS AND DISCUSSION

Bensulfuron methyl inhibited tuber formation by sprouting tubers at lower concentrations than it did the root crowns (Table 1). It has been observed in field treatments that hydrilla sprouting from tubers and turions is more susceptible to bensulfuron methyl than mature plants. The susceptibility of plants to the sulfonylurea herbicides varies greatly depending upon several factors, growth stage of the plant being a major one (Beyer et al. 1988).

The inhibition of tuber formation in the plants treated once (Sep) and harvested (Jun) after the tuber forming period was more variable than those of the other treatments. Plants treated at 15 ppb bensulfuron methyl produced as many or more tubers than the control plants, however 20 ppb or higher concentrations greatly reduced tuber formation by both plant types.

Plants treated twice during the reproductive period showed that bensulfuron methyl concentrations of 10 ppb or higher are required to obtain reductions in tuber formation by root crowns, and 5 ppb or higher by sprouting tubers.

Untreated hydrilla planted in Sep and harvested in Jan (4 mo exposure) and those planted in February and harvested in Jun (4 mo exposure) produced approximately the same number of tubers. Also, there appear to be little differences in plant susceptibility during these two different portions of the reproductive period. Significant tuber inhibition in plants derived from root crowns required 5 to 10 ppb and plants derived from tubers required 5 ppb to produce reductions in tuber formation.

Plant and root dry weights collected at harvest (not shown) indicated that plants were alive at the end of the treatments and growth was suppressed similar to that reported by Anderson and Dechoretz (1988). It is not possible to determine, due to the destructive harvest, if the treated hydrilla plants would recover from the treatments. Hydrilla treated with bensulfuron methyl dies slowly in comparison to treatments with contact herbicides. Whether bensulfuron methyl applied at these rates acted as a plant growth regulator, or was toxic to the plants, is not as important as the fact that reproduction was reduced. In these closed systems, prevention of reproduction by hydrilla for the entire 8 month short-day period required a treatment of 20 ppb bensulfuron methyl. If two treatments during the reproductive season were planned, it appears from these data that 10 ppb would be the minimum concentration required to reduce reproduction depending upon the source of the regrowth. If regrowth was solely derived from germinating tubers and turions, two treatments of 5 ppb bensulfuron methyl may be sufficient to prevent reproduction.

Further research needs to be conducted on rate and exposure periods, however recent field bensulfuron methyl applications in Lake Bonnet on the Withlacoochee River have shown that bensulfuron methyl can be used to prevent hydrilla reproduction by germinating hydrilla tubers and turions under field conditions (unpublished data) and integrates well into the Withlacoochee River hydrilla control program.

ACKNOWLEDGMENTS

This research was supported in part by USDA-ARS and the University of Florida Institute of Food and Agricultural Sciences Cooperative Agreement No. 58-43YK-9-0001.

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