YELLOW NUTSEDGE TUBER CONTROL AND DRY BULB ONION YIELD WITH SOIL FUMIGATION AND FALLOW

Joel Felix, Joey Ishida, Clinton C. Shock, and Erik Feibert
Malheur Experiment Station
Oregon State University
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Introduction

Yellow nutsedge has become a major problem in the Treasure Valley of eastern Oregon and southwestern Idaho, especially in fields planted to onions. Control of yellow nutsedge presents a major challenge because of its ability to reproduce by underground propagules (rhizomes and tubers). Without effective control, yellow nutsedge can produce millions of tubers per acre in a single season. Successful control of yellow nutsedge in the Treasure Valley will partly rely on tuber destruction by effective fumigation procedures. There are indications that the use of Telone® C-17 soil fumigant could enhance the control of yellow nutsedge if applied prior to fumigation by Vapam®. Similarly, supplementing soil fumigants with fall application of Dual Magnum® herbicide could provide synergistic effects and enhance nutsedge control. Consequently, this study was established to study the effectiveness of Telone C-17, Vapam, and Dual Magnum when applied alone and the synergistic effects of combination treatments in reducing yellow nutsedge tuber viability in fields intended for onion production.

Materials and Methods

The trial was conducted in a field severely infested with yellow nutsedge, approximately 2 miles from the Malheur Experiment Station, Ontario, Oregon. The predominant soil was an Owyhee silt loam. The field was furrow irrigated on September 1 and disked on September 7, 2006. The experimental design was a randomized complete block with four replicates. Each plot was 16 ft wide and 60 ft long. On September 8, 2006, 3 soil cores (4.25-inch diameter each) were taken from the center of the plot with subsamples spaced 1 ft apart. Soil core samples were taken and divided into 2 depths: 0 to 12 inches and 12 to 16 inches. Yellow nutsedge tubers from each sample were separated by washing and sieving, counted, and weighed. Tubers were placed in open plastic bags in a dark cooler at 40°F until counted. The treatments tested included two fumigants (Telone C-17 and Vapam) and Dual Magnum herbicide either as stand-alone applications or in combinations as complete factorial with four replicates (Table 1). An untreated check was also included.

Telone C-17 soil fumigant was shanked into the respective plots at 23 gal/acre (238 lb ai/acre) on September 12, 2006. The soil fumigant was shanked in at 18-inch depth using tractor-drawn equipment with shanks spaced 20 inches apart. Vapam soil fumigant was shanked in to the respective plots at 50 gal/acre (213 lb ai/acre) on

October 6, 2006. Vapam was shanked into the soil both at 10- to 12-inch depth and 5- to 6-inch depth using tractor-drawn equipment with shanks spaced 5 inches apart. Dual Magnum was broadcast on the soil surface to the respective plots at 2 pt/acre (1.9 lb ai/acre) on October 26, 2006. The field was disked twice subsequent to Dual Magnum application. On October 27, 2006, the field was plowed to a 10-inch depth by Simplot Growers Solutions to thoroughly mix the Dual Magnum into the treated plots. Dual Magnum at 1.33 pt/acre is registered as a plow-down treatment the fall preceding onion in the Treasure Valley of eastern Oregon and southwestern Idaho. On November 14, 2006, the field was roller harrowed twice. Soil core samples were taken on October 20, 2006 in the same number, size, and depth as before fumigating. The tubers were separated from soil, counted, and weighed.

Procedures for 2007

In order to further degrade the tubers, the study area was fallowed in 2007, and the integrity of individual plots was maintained by corner triangulation and working the soil in one direction to avoid cross contamination of different treatments. Plots were evaluated for yellow nutsedge emergence and counts done on May 3, 2007 when seedlings were small to enable identification of individual plants. Additionally, five soil cores from each plot were taken on March 27, 2007 to characterize and quantify tuber population density following treatment application and were processed using the methodology described above. The plots were treated with Roundup OriginalMax® at 32 fl oz/acre plus ammonium sulfate (AMS) at 3.2 pt/acre beginning May 25, 2007 and repeated on June 13, 2007. The study area was disked on July 20, 2007, re-bedded, and irrigated to encourage yellow nutsedge emergence. The final Roundup plus AMS was applied on August 20, 2007 for a total of three applications during the summer 2007. Outlook® at 21 fl oz/acre was applied on June 12, 2007 to enhance yellow nutsedge control.

The study area was disked, roller harrowed twice, bedded, and irrigated during fall 2007, ready for planting onions in 2008. Five soil samples, each measuring 4.25 inches in diameter and 12 inches deep, were taken from each plot on November 19, 2007 and processed for tuber recovery by washing and sieving. The tubers were counted and weighed for each plot and placed in ziplock plastic bags and stored in a dark cooler at 40°F for use in other studies.

Procedure for 2008

The beds formed in the preceding fall season were harrowed on March 14, 2008. Onion variety 'Vaquero' was planted on March 19, 2008 in double rows spaced 3 inches apart with seeds dropped at 3.9-inch spacing within the row. Each double row was planted on beds spaced 22 inches apart with individual plots measuring 7.33 ft wide and 60 ft long. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. The onion rows received 3.7 oz of Lorsban® 15G per 1,000 ft of row (0.82 lb ai/acre) on March 20.

All plots except the untreated control were sprayed with Outlook plus Select Max® herbicides at 21 fl oz/acre each on May 30, 2008. All herbicide treatments were applied

using a CO_2-pressurized backpack sprayer equipped with TeeJet nozzles calibrated to deliver 20 gal of spray solution per acre. On June 16, 2008, the onions were fertilized with 180, 20, and 3 lbs of nitrogen, potassium, and zinc per acre, respectively. Preventive sprays of Success® (8 fl oz/acre) and Ad-Wet (1qt/acre) commenced on June 25 and continued on a calendar schedule until the beginning of July, 2008. All plots (except the untreated control) were sprayed with Dual Magnum (1.33 pt/acre) on June 25, 2008. The onions were harvested from 2 center rows and 20-ft length on September 4, 2008. Dry bulb onions were graded and separated according to quality: bulbs without blemishes (No. 1s) and split bulbs (No. 2s). The No. 1 bulbs were graded according to diameter into small (<2.25 inches), medium (2.25-3 inches), jumbo (3-4 inches), colossal (4-4.25 inches), and supercolossal (>4.25 inches).

The data were statistically analyzed and means separated using Fisher's least significant difference test at the 5 percent probability level (LSD, $P = 0.05$).

Results and Discussion

Because the 2006 results indicated that substantially more tubers were produced in the 0- to 12-inch depth than at the 12- to 16-inch depth (Shock et al. 2006), all soil samples for tuber characterization in 2007 and 2008 were taken to the 12-inch depth only. The data for yellow nutsedge tubers before and after fumigation in 2006 are presented in Table 1 to indicate changes over time. Yellow nutsedge seedling counts during spring 2007 indicated a significantly lower density in plots treated with Telone C-17, followed by Vapam and Dual Magnum (data not shown), compared to other treatments. Similarly, the synergistic effect of Telone C-17, Vapam, and Dual Magnum resulted in a pronounced reduction in the number of tubers produced (Table 1). Telone C-17 in combination with Vapam or Dual Magnum resulted in significantly fewer tubers compared to each product used alone. Similar results were observed when Vapam was used in combination with Dual Magnum. Soil samples taken during fall 2007 and 2008 indicated similar trends, with a combination of Telone C-17, Vapam, and Dual Magnum having the lowest number of tubers.

The marketable onion yield for the tested treatments is presented in Table 2. There was no significant difference in yield among treatments, even though number of yellow nutsedge tubers was significantly lower in combination treatments. The results confirm the observation that yellow nutsedge tubers tend to increase in the field following onion production. Growers are advised to grow corn in rotation the year following onions to help drive down the number of yellow nutsedge tubers.

Currently, Dual Magnum is registered for use in Oregon and Idaho as a fall plow-down treatment in the year preceding onion. Proper use of fall plow-down Dual Magnum in combination with Telone C-17 or Vapam will provide appreciable levels of yellow nutsedge control.

References

Shock, C. C., J. Ishida, and E. Feibert. 2006. Yellow nutsedge nutlet production in response to nutlet planting depth. Oregon State University Agricultural Experiment Station Special Report 1075:160-162.

Table 1. Yellow nutsedge population density (per ft^2) and corresponding weight (grams/ft^2) in response to soil fumigation (fall 2006) followed by fallow (2007), and dry bulb onions in 2008 at the Malheur Experiment Station, Oregon State University, Ontario, OR.

				Yellow nutsedge (number and weight)‡								
				Before fumigation				Spring 2007	Fall 2007		Fall 2008	
				0-12" depth		12-16" depth			0-12" depth			
				9/8/2006		9/8/2006		3/8/2007	11/26/2007		9/10/2008	
Treatment	Rate	Unit	Timing†	No. of Tubers	Tuber wt (oz)	No. of Tubers	Tuber wt (oz)	No. of Tubers	No. of Tubers	Tuber wt (oz)	No. of Tubers	Tuber wt (oz)
				per ft^2								
Vapam	50	gal/a	B	1,320 a	1.9 a	11 a	1.1 a	211 cd	112 cd	0.4 Bc	270 bc	0.9 bc
Dual Magnum	2	pt/a	C	2,130 a	2.1 a	7 a	0.4 a	326 bc	258 b	0.8 B	446 b	1.5 b
Telone C-17	23	gal/a	A	1,835 a	1.6 a	8 a	0.5 a	273 bcd	177 bc	0.5 Bc	200 bc	0.8 bc
Vapam;	50	gal/a	B	1,091 a	1.2 a	2 a	0.1 a	133 cd	96 cd	0.3 Bc	121 c	0.5 bc
Dual Magnum	2	pt/a	C									
Telone C-17;	23	gal/a	A	1,835 a	1.7 a	5 a	0.4 a	176 cd	63 d	0.2 Bc	122 c	0.5 bc
Vapam	50	gal/a	B									
Telone C-17;	23	gal/a	A	1,140 a	1.1 a	9 a	0.4 a	430 ab	161 bcd	0.5 Bc	307 bc	1.2 bc
Dual Magnum	2	pt/a	C									
Telone C-17;	23	gal/a	A	540 b	0.6 a	3 a	0.1 a	85 d	57 d	0.2 C	183 c	0.7 bc
Vapam;	50	gal/a	B									
Dual Magnum	2	pt/a	C									
Untreated				850 a	0.9 a	4 a	0.3 a	614 a	871 a	3.3 A	1,134 a	5.2 a

† A = Applied 9/12/2006; B = 10/6/2006; C = 10/26/2006. Plots were fallowed in 2007 and planted to onions in 2008.
‡ Means within a column followed by same letter do not significantly differ (LSD, $P = 0.05$)

Table 2. Marketable onion yield in 2008 in a field fumigated in 2006 and fallowed in 2007 at the Malheur Experiment Station, Oregon State University, Ontario, OR.

Treatment	Rate	Unit	Timing[†]	Marketable yield by grade[‡]					
				Small <2.5 in	Medium 2.25-3 in	Jumbo 3-4 in	Colossal 4-4.25 in	Supercolossal >4.25 in	Total marketable 2.25->4.25 in
				CWT/acre					
Vapam	50	gal/a	B	31 a	157 a	310 A	3 a	0 a	501 A
Dual Magnum	2	pt/a	C	38 a	162 a	163 A	12 a	0 a	375 A
Telone C-17	23	gal/a	A	25 a	151 a	304 A	2 a	0 a	481 A
Vapam;	50	gal/a	B	29 a	138 a	301 A	19 a	1 a	488 A
Dual Magnum	2	pt/a	C						
Telone C-17;	23	gal/a	A	22 a	154 a	346 A	11 a	0 a	533 A
Vapam	50	gal/a	B						
Telone C-17;	23	gal/a	A	28 a	160 a	289 A	0 a	0 a	477 A
Dual Magnum	2	pt/a	C						
Telone C-17;	23	gal/a	A	22 a	137 a	291 A	3 a	0 a	453 A
Vapam;	50	gal/a	B						
Dual Magnum	2	pt/a	C						
Untreated				38 a	154 a	217 A	2 a	0 a	410 A

[†] A = Applied 9/12/2006; B = 10/6/2006; C = 10/26/2006. Plots were fallowed in 2007 and planted to onions in 2008.
[‡] Means within a column followed by same letter do not significantly differ (P = 0.05, LSD)