CONTROL OF YELLOW NUTSEDGE WITH EFFECTIVE CROP ROTATIONS

Joel Felix and Joey Ishida, Malheur Experiment Station, Oregon State University, Ontario, OR, 2011

Introduction

There are relatively fewer herbicides registered for weed management in many specialty crops compared to agronomic crops. Consequently, growers often take advantage of the wider array of herbicides available for use in agronomic crops grown in rotation to manage weed species that are difficult to control in vegetable crops. Yellow nutsedge has become a major weed problem in many agricultural fields in the Treasure Valley of eastern Oregon and southwestern Idaho. The severity of damage and negative effects of yellow nutsedge are especially noticeable when fields are planted to direct-seeded onions. Surveys have indicated an average of 42 percent loss of onion yield in fields heavily infested with yellow nutsedge.

Control of yellow nutsedge presents a challenge because of its ability to reproduce by rhizomes and tubers that are able to survive in the soil for 3 to 4 years. Farming activities, particularly tillage and irrigation, play a significant role in yellow nutsedge distribution in infested fields. Therefore, successful control of yellow nutsedge in the Treasure Valley will require integrated approaches including effective crop rotations and use of herbicides with proven efficacy in every crop grown in a rotation. The objective of this study was to evaluate the effect of tillage, crop rotation, and herbicides on yellow nutsedge control in years preceding onion.

Materials and Methods

The study was initiated in 2007 in a field heavily infested with yellow nutsedge near the Malheur Experiment Station, Ontario, Oregon. The study was a split-plot design with tillage (reduced and conventional) forming the main plots onto which three crop rotations and herbicide treatments were imposed as subplots. Each year the crops were planted on 22-inch beds. The rotations were designed so that the terminal crop would be onion in 2011. Rotations were: 1) corn/corn/sugar beet/wheat/onions; 2) corn/sugar beet/corn/wheat/onions; and 3) corn/corn (late planting)/pinto bean/wheat/onions. The treatments used in each crop are presented in Table 1.

Conventionally tilled plots were moldboard plowed each year and groundhogged twice before forming beds to facilitate furrow irrigation. Reduced-tillage plots were disked only twice to avoid deep tillage, which is believed to redistribute tubers within the soil profile. Fertilizer was applied to provide nutrients as determined by soil tests and using University recommendations in 2007–2010. In 2007, the entire study was planted to Dekalb Roundup Ready® (RR) corn hybrid DK-51-39 with seeds spaced 7 inches within the row. Rotational crops in 2008 were RR corn hybrid DK C52-59 planted on May 15 and RR sugar beet variety (Beta CT 01RR07) planted on April 18. Rotational crops in 2009 were RR corn hybrid DKC 52-59, RR sugar beet BTS 26RR14, and pinto bean variety ‘Othello’. Corn and sugar beet were mechanically planted in respective plots at 7 inches spacing within the row and 6 seeds/ft of row, respectively. Pinto beans were seeded at 80 lb/acre. The entire study area was planted to winter wheat during fall 2009.

Counter® 15-G insecticide was banded over the sugar beet rows at 7.4 lb/acre (terbufos at 1.11 lb ai/acre) immediately after planting. Sugar beet rows were sidedressed with Temik® 15G at 10 lb/acre (aldicarb at 1.5 lb ai/acre) 53 days after planting. Sugar beet and pinto beans were treated with Quadris® at 4 oz/acre (azoxystrobin + chlorothalonil at 2.75 oz ai/acre) on May 22 and June 11 as a preventive measure against rhizoctonia. Sugar beets were thinned on May 28, 2008 to 8-inch spacing within the row. Weeds in wheat were controlled using Bronate® Advanced (bromoxynil + MCPA) herbicide in 2010.

Wheat stubble was flailed immediately after harvest in 2010 and the plots were moldboard plowed and disked or only disked as practiced in previous years. The field was bedded on 22-inch spacing on November 1, 2010. The beds were harrowed down and onion variety 'Vaquero' was planted on April 4, 2011. Lorsban® 15G insecticide was applied at 3.7 oz/1,000 ft of row (chlorpyrifos at 0.101 lb ai/acre) on April 18. The list of herbicides used in each treatment in 2011 is presented in Table 2. Movento® insecticide at 5 fl oz/acre (spirotetramat at 0.078 lb ai/acre) tank-mixed with Pierce (crop oil concentrate) at 1.57 lb ai/acre was applied on June 13 to control onion thrips. Onions were sprayed again for thrips control on June 22 and July 5 using Radiant® at 10 fl oz/acre (spinetoram at 0.078 lb ai/acre) tank-mixed with crop oil at 1 qt/100 gal of water. The final spray for thrips control was on July 24 using Lannate® at 3 pt/acre (methomyl at 0.9 lb ai/acre).

Onion plant tops were flailed on September 8 and bulbs were lifted on September 13 and left on the ground to cure. Bulbs were handpicked from 15 ft of the two center rows on September 20 and graded for quality and yield on September 23, 2011 using USDA standards.

Soil sampling to quantify initial yellow nutsedge tuber density was conducted during spring 2007 after beds were formed and the field irrigated. The process was repeated at the end of each crop year to quantify changes in yellow nutsedge tubers in response to treatments. Five soil cores measuring 4.25 inches in diameter and 12 inches deep each were taken randomly from each subplot. The soil was processed to recover yellow nutsedge tubers using a washing and sieving method. Tubers from each plot were placed in a self-seal plastic bag (ziplock plastic bags) and stored in the dark at 40°F until they were counted and weighed.

Herbicides used on corn in 2007 and rotational crops in 2008–2010 are presented in Table 1. All herbicide treatments were applied using a tractor with a sprayer boom equipped with 8002EVS Teejet nozzles calibrated to deliver 20 gal of solution per acre. The study was furrow irrigated as needed on a calendar schedule to maintain moisture in the top 12 inches of the soil profile. Crops were harvested for yield at maturity from 20 ft of the two center rows of each subplot. The data were subjected to analysis of variance and means were compared using LSD at $P = 0.05$.

Results and Discussion

Yellow nutsedge tubers were relatively uniformly distributed across the field at the beginning of the study in 2007 (Table 3). The herbicide treatments in 2007 reduced the yellow nutsedge tuber population density relative to the untreated control. Because there was no significant difference between tillage for yellow nutsedge tuber population density in 2007, the average is presented in Table 3. Conventional tillage provided the greatest yellow nutsedge tuber reduction from 2008 to 2010 regardless of the crops used in the rotation (Table 3). Yellow nutsedge population density dramatically increased in the untreated treatment in 2008 and 2009 relative to plots treated with herbicides. Interestingly, the number of tubers in the untreated control was reduced by the winter wheat in 2010. Even though the reduction was not as high as that provided by the herbicide treatments in the same year, it is consistent with the fact that yellow nutsedge does not tolerate shading that is provided by fall-planted winter wheat.

The list of herbicides used in each treatment to control weeds in onion in 2011 is presented in Table 2. There was a dramatic increase in yellow nutsedge tubers at the end of 2011, reflecting the inability of onions to compete with yellow nutsedge (Table 3). The highest increase in yellow nutsedge tubers was observed in reduced tillage plots. These results indicate that conventional tillage was best suited to manage yellow nutsedge in onion-based crop rotations.

Yellow nutsedge control in onion averaged greater than 90 percent across herbicide treatments within the conventional tillage system compared to the untreated control (Table 4). Control was 57 to 78 percent for onions grown under the reduced tillage system. These results further demonstrate that yellow nutsedge was best controlled under conventional tillage.

At the conclusion of the 2010 cropping season, the conventionally tilled corn/corn/sugar beet/wheat rotation resulted in the lowest average yellow nutsedge tubers across herbicide treatments (239 tubers/yd^2) compared to 359 and 396 tubers/yd^2 for the corn/sugar beet/corn/wheat and corn/corn/pinto bean/wheat rotations, respectively (Table 3).

The best onion yield was obtained from the conventionally tilled plots (Table 5). Conventionally tilled corn/corn (planted late)/pinto bean/wheat rotation provided the highest marketable onion yield ranging from 1,160 to 1,271 cwt/acre. Onion yield was generally lower in reduced tillage plots regardless of the rotation used.

The results from this study indicate that the greatest yellow nutsedge reduction could be obtained with conventional tillage and the corn/corn/pinto bean/wheat crop rotation. Substituting pinto beans with sugar beet might provide similar benefits if the field did not have a history of rhizoctonia. Rhizoctonia affected sugar beet plant stands and created open patches that allowed yellow nutsedge to grow and produce additional tubers. In heavily infested fields, growing corn for 2 years followed by another crop prior to planting onion would provide the best yellow nutsedge tuber reduction.

Table 1. Yearly list of treatments used in the rotational study to control yellow nutsedge in different crops at Malheur Experiment Station Ontario, OR, 2007-2010.

2007[a]
Conventional and reduced tillage
Corn
1. Untreated
2. Dual II Magnum 1.67 pt/acre (PRE); followed by Roundup 32 fl oz/acre (POST) + AMS 3.2 pt/acre
3. Dual II Magnum 1.67 pt/acre (PRE); followed by Dual II Magnum 1.67 pt/acre (POST) + Roundup 32 fl oz/acre + AMS 3.2 pt/acre
4. Dual II Magnum 2.5 pt/acre (PRE); followed by Basagran 1.5 pt/acre (POST) + Roundup 32 fl oz/acre + AMS 3.2 pt/acre
5. Dual II Magnum 3 pt/acre (PRE); followed by Basagran 2 pt/acre (POST) + Roundup 32 fl oz/acre + AMS 3.2 pt/acre

2008		
Rotational crops in conventional and reduced tillage		
Corn	**Sugar beet**	**Corn (late)**
Untreated	Untreated	Untreated
Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Eptam 4.5 pt/acre (PPI) Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre
Outlook 14 oz/acre (PPI) Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Nortron 12 oz/acre (PPI) Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + Eptam 3.5 pt/acre (POST2) + AMS 3.2 pt/acre	Outlook 14 oz/acre (PPI) Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre
Eradicane 6 pt/acre (PPI) Roundup 22 oz/acre (POST1) + Basagran 1.5 pt/acre + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Outlook 21 oz/acre (PPI) Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + Nortron 12 oz/acre (POST2) + AMS 3.2 pt/acre	Dual II Magnum 1.33 pt/acre (PPI) Roundup 32 oz/acre (POST1) + Basagran 1.5 pt/acre + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre
Outlook 18 oz/acre (PPI) Roundup 22 oz/acre (POST1) + Basagran 2 pt/acre + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + Dual II Magnum 1.33 pt/acre + AMS 3.2 pt/acre	Dual II Magnum 1.33pt/acre (POST1) +Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Dual II Magnum 1.33pt/acre (POST2) Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Dual II Magnum 1.33 pt/acre (PPI) Eptam 4.5 pt/acre (PPI) Roundup 32 oz/acre (POST1) + Basagran 1.5 pt/acre + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre

[a] All plots were planted to corn in 2007. Conventional and reduced tillage plots were sprayed with the same herbicide rates as indicated for each year. The main plots were divided into three plots and the rotational crops planted as shown in 2008 and 2009.

Table 1. continued

2009		
Rotational crops in conventional and reduced tillage		
Sugar beet	**Corn**	**Pinto beans**
1. Untreated	Untreated	Untreated
2. Roundup 22 oz/acre (POST1) + Outlook 21 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Outlook 21 oz/acre (PPI) Raptor 4 oz/acre (POST) + Basagran 0.75 pt/acre + AMS 3.2 pt/acre
3. Roundup 22 oz/acre (POST1) + Outlook 10.5 oz/acre + AMS 3.2 pt/acre	Outlook 21 oz/acre (PPI) Roundup 22 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre	Outlook 14 oz/acre (PPI) Outlook 7 oz/acre (POST1) + Basagran 0.75 pt/acre + AMS 3.2 pt/acre Basagran 1.5 pt/acre (POST2) + AMS 3.2 pt/acre
4. Roundup 21 oz/acre (POST1) + Outlook 21 oz/acre + AMS 3.2 pt/acre Roundup 21 oz/acre (POST2) + Nortron 5 oz/acre + AMS 3.2 pt/acre Roundup 22 oz/acre (POST3) + AMS 3.2 pt/acre	Dual II Magnum 1.5 pt/acre (PPI) Roundup 22 oz/acre (POST1) + Basagran 2 pt/acre + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + AMS 3.2 pt/acre + AMS 3.2 pt/acre	Dual Magnum 1.33 (PPI) Basagran 1 pt/acre (POST1) + Raptor 4 oz/acre + AMS 3.2 pt/acre Basagran 1.5 pt/acre (POST2) + AMS 3.2 pt/acre
5. Roundup 22 oz/acre (POST1) + Outlook 21 oz/acre (POST1) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + Dual Mag 1.33 pt/acre (POST2) + AMS 3.2 pt/acre Roundup 22 oz/acre (POST3) + AMS 3.2 pt/acre	Dual II Magnum 1.5 pt/acre (PPI) Roundup 22 oz/acre (POST1) + Basagran 2 pt/acre + AMS 3.2 pt/acre Roundup 22 oz/acre (POST2) + Basagran 1.5 pt/acre + AMS 3.2 pt/acre	Dual Magnum 1.33 (PPI) + Treflan 1.5 pt/acre Basagran 1 pt/acre (POST1) + Outlook 18 oz/acre + AMS 3.2 pt/acre Basagran 2 pt/acre + COC 2 pt/acre

2010[a]		
Conventional and reduced tillage		
Wheat	**Wheat**	**Wheat**
1. Untreated	Untreated	Untreated
2. Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre
3. Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre
4. Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre
5. Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre	Bronate Advanced 1.66 pt/acre

[a] All wheat plots in 2010 were treated with Bronate Advanced 1.66 pt/acre

Table 2. List of herbicide treatments in 2011 for yellow nutsedge control following 4 years of crop rotation and different tillages at the Malheur Experiment Station, Ontario, OR.

Treatment	Rate lb ai/acre	Application timing	Date
1. Untreated			
2. Prowl H2O	0.95	PRE	May 3
GoalTender + Buctril	0.25 + 0.125	POST	June 9
3. Prowl H2O fb	0.95	PRE	May 3
Outlook	0.98	POST	May 25
GoalTender + Buctril	0.25 + 0.125	POST	June 9
4. Nortron	0.5	PRE	May 3
Prowl H2O	0.95	PRE	May 3
Outlook	0.98	POST	May 25
GoalTender + Buctril	0.25 + 0.125	POST	June 9
5. Nortron	0.5	PRE	May 3
Prowl	0.95	PRE	May 3
Outlook	0.98	POST	May 25
GoalTender + Buctril	0.25 + 0.125	POST	June 9

Table 3. Yellow nutsedge tuber (numbers/yd^2) changes in response to tillage and herbicide treatments at Malheur Experiment Station Ontario, OR from 2007 to 2010 and following onion in 2011.

	2007	
	Spring	Fall
Treatment[a]	Corn	
	--------- tubers/yd^2 ----------	
1	5,988 a[b]	9,962 a
2	5,146 a	2,197 b
3	5,867 a	2,559 b
4	5,707 a	3,178 b
5	4,274 a	2,155 b

	2008					
	Conventional tillage			Reduced tillage		
Treatment[a]	Corn	Sugar beet	Corn (late)	Corn	Sugar beet	Corn (late)
	------------------------------ tubers/yd^2 ------------------------------					
1	11,173 a	15,187 a	8,541 a	14,843 a	20,040 a	8,964 a
2	984 b	1,056 b	966 b	1,431 b	1,412 b	996 b
3	1,129 b	670 b	875 b	1,243 b	990 b	1,630 b
4	1,835 b	1,388 b	1,044 b	1,612 b	1,497 b	1,243 b
5	1,750 b	1,756 b	736 b	1,738 b	911 b	1,038 b
	2009					
	Sugar beet	Corn	Pinto bean	Sugar beet	Corn	Pinto bean
1	17,040 a	14,366 a	10,243 a	13,376 a	24,567 a	13,841 a
2	537 b	773 b	453 b	984 b	990 b	1,008 b
3	869 b	1,086 b	531 b	797 b	881 b	1,014 b
4	917 b	1,195 b	435 b	857 b	1,262 b	954 b
5	392 c	887 b	513 b	972 b	525 c	839 b
	2010					
	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat
1	4,992 a	10,720 a	7,418 a	6,084 a	11,855 a	7,292 a
2	254 b	423 b	447 b	410 b	471 b	954 b
3	175 c	332 b	453 b	338 b	386 b	718 b
4	380 b	314 b	392 b	332 b	598 b	899 b
5	145 c	368 b	290 b	338 b	435 b	592 b
	2011					
	Onion	Onion	Onion	Onion	Onion	Onion
1	15,875 a	18,187 a	15,428 a	15,060 a	18,519 a	16,436 a
2	748 b	2,294 b	1,062 b	1,992 b	2,710 b	2,095 b
3	1,014 b	1,461 b	875 b	2,668 b	2,903 b	1,672 b
4	362 b	1,533 b	561 b	2,179 b	1,274 b	2,239 b
5	290 b	549 c	320 b	1,473 b	1,080 b	1,503 b

[a]Herbicides used in each treatment and year are listed in table 1.
[b]Means within a column with the same letter are not significantly different (LSD, P = 0.05).

Table 4. Yellow nutsedge control in response to different treatments in 2011, Malheur Experiment Station, Ontario, OR.

Treatment[a]	Yellow nutsedge control					
	Corn/corn/sugar beet/wheat		Corn/sugar Beet/corn/wheat		Corn/corn(late)/pinto beans/wheat	
	Conventional	Reduced	Conventional	Reduced	Conventional	Reduced
	---------------- % ----------------		---------------- % ----------------		---------------- % ----------------	
1	0	0	0	0	0	0
2	98	72	90	73	94	78
3	94	57	92	73	93	77
4	94	60	87	68	94	77
5	98	72	93	83	98	78
LSD 0.05	14		14		14	

[a]Treatment names are listed in Table 2.

Table 5. Marketable onion yield in response to different treatments at the Malheur Experiment Station, Ontario, OR, 2011.

	Marketable onion yield							
	Conventional tillage				Reduced tillage			
Treatment[a]	Medium	Jumbo	Col + S Col[b]	Marketable	Medium	Jumbo	Col + S Col	Marketable
	cwt/acre							
	Previous crops: corn/corn/sugar beet/wheat							
1	81	1	7	89	39	1	0	41
2	217	779	41	1,036	151	710	16	877
3	218	813	41	1,072	151	720	79	950
4	157	936	97	1,190	178	745	21	944
5	259	836	5	1,099	152	742	86	981
LSD 0.05	84	257	73	264	84	257	73	264
	Previous crops: corn/sugar beet/corn/wheat							
1	24	0	0	24	43	3	0	46
2	94	612	111	816	254	606	19	879
3	79	618	140	836	160	808	72	1,040
4	74	695	157	926	189	663	37	889
5	64	578	192	833	162	746	80	988
LSD 0.05	84	257	73	264	84	257	73	264
	Previous crops: corn/corn(late)/pinto beans/wheat							
1	24	0	0	24	64	2	0	66
2	137	1,022	74	1,233	246	542	0	788
3	121	855	125	1,101	222	619	18	858
4	137	1,007	127	1,271	236	700	12	949
5	138	880	142	1,160	228	725	52	1,005
LSD 0.05	84	257	73	264	84	257	73	264

[a] Treatment names are listed in Table 2 above.

[b] Col + S Col = Colossal and Super Colossal onion sizes.