CONTROLLING YELLOW NUTSEDGE (*CYPERUS ESCULENTUS* L.) WITH COMPETITION FROM COVER CROPS — PRELIMINARY RESULTS

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Introduction

Yellow nutsedge (YNS) is a problematic weed in onion production systems in eastern Oregon. The high-moisture, high-light conditions found in onion fields allow YNS to thrive (Ransom et al., 2009). Few herbicides are available for the selective control of YNS in onion fields, so cultural practices that limit its growth will be valuable to growers. The goal of this project is to evaluate the YNS suppression potential of planting a cover crop in the fall before onions are grown, both with and without herbicide application. Cover crops are expected to help suppress YNS through competition (Sturm et al., 2018) and will hopefully complement existing weed control practices such as herbicides. Thus far in our current project, YNS has been established in experimental enclosures, and 1 year of cover crop and herbicide treatments has been applied. The effects of the treatments will be measured during spring 2020 when YNS emerges. Treatments will be applied again during fall 2020 to collect a second year of data.

Materials and Methods

The experiment was conducted on an Owyhee silt loam soil. A soil analysis on August 15, 2019, showed a pH of 8.5, 3.1% organic matter, 5 ppm nitrate-nitrogen (N), 3 ppm ammonium-N, 16 ppm phosphorus, 321 ppm potassium, 51 ppm sulfate, 3794 ppm calcium, 366 ppm magnesium, 163 ppm sodium, 2.6 ppm zinc, 1.3 ppm copper, 4 ppm manganese, 12 ppm iron, and 0.3 ppm boron.

Compatibility of Cover Crops and Herbicide

To test whether or not the cover crop and herbicide treatments were compatible, a separate small plot study was established to evaluate the emergence of four cover crop varieties when treated with Dual Magnum® herbicide. Four cover crop varieties (Master mustard, Control radish, Purpletop rutabaga, and Ethiopian cabbage) were planted on July 9, 2020 in a randomized complete block design with four replicates. Immediately before planting cover crops, Dual Magnum herbicide was applied at 1.33 pt/acre to the eastern half of each plot. This arrangement ensured that herbicide-treated soil was not moved into untreated areas. The herbicide was incorporated by lightly rototilling and the cover crops were planted at ½-inch depth and 6-inch row spacing. Seeding rates were based on seed dealer recommendations: Master mustard, 20 lb/acre; Control radish 25 lb/acre; Purpletop rutabaga and Ethiopian cabbage, 7 lb/acre. The

herbicide treatment at planting reduced the emergence of the cover crops. Based on the results of this test, we selected the two most vigorous cover crops for planting in enclosures and waited to apply the herbicide treatments until after cover crop emergence.

Enclosures

In October 2018, 36 enclosures were made from 14-inch-wide by 19-ft-long galvanized metal flashing with the ends riveted together to create circular enclosures 6 ft in diameter. The rings were buried to a depth of 12 inches in an area of tilled soil known to be free of YNS. Wheat was grown to simulate the common practice of farmers who typically plant onions in the spring the year after wheat harvest. Wheat (cultivar: Ovation) was planted by hand in rows spaced 6 inches apart on October 25 and 26, 2018, at 120 lb/acre and 1 inch deep. The plots were irrigated with sprinklers, and Watermark sensors were used to determine irrigation timing. On April 2, 2019, 217 lb N/acre was applied as urea to the plots.

Yellow Nutsedge Establishment

Establishing YNS with competition from wheat proved difficult. Tubers were collected from a local heavily infested area on March 22, 2019, rinsed, and stored in the refrigerator at 4 °C for 14 days to promote even germination. On April 5, 2019, tubers were placed in gallon Ziploc bags in a single layer on moist paper towels and moved to a germinator set to 20 °C at night and 25 °C during the day. Germinated tubers were separated by size, and medium-sized mature tubers were selected for planting. On April 11, 2019, four tubers were planted in each plot (circular ring) 1 inch deep. Tuber placement was halfway between the center and edge of the plot and equally spaced around the center. The first tubers did not establish, so additional tubers were planted on May 8, 2019 and irrigation was increased. The wheat was cut at soil level in a 1-foot radius around the developing YNS plants on May 31, 2019 to reduce competition and promote YNS growth. YNS plants were still small when wheat was harvested, so additional tubers were collected, and 10.1 g of tubers (about 50 tubers) were spread in each plot when cover crops were planted on August 22, 2019.

Treatments

In August 2019, the wheat was harvested and cover crop and herbicide treatments were applied to the enclosures. The experiment was a three by two factorial design with three cover crop treatments (Control radish, Master mustard and no cover crop) and two herbicide treatments (Dual Magnum and no herbicide), resulting in a total of six unique treatments. The treatments were assigned to the plots in a randomized complete block design with six replicates.

Cover Crop Establishment

Wheat was harvested on August 12, 2019, and the plots were rototilled on August 20, 2019. On August 22, fertilizers were broadcast applied based on soil analysis. Elemental sulfur at 200 lb/acre and phosphate at 50 lb/acre were applied to all plots. Plots where cover crops were planted also received N at 110 lb/acre. YNS tubers were seeded to all plots as described above. Master mustard and Control radish cover crops were broadcast seeded at 20 and 25 lb/acre respectively and lightly incorporated with a hand cultivator. The plots were irrigated after planting and again on August 25, to ensure germination. After the cover crops had emerged, Dual Magnum (1.33 pt/acre) was applied to respective treated plots on 28 August, and ½ inch of irrigation was applied with sprinklers to incorporate the herbicide in the soil.

Cover Crop Termination and Biomass Measurement

On October 24, 2019, samples were taken to measure cover crop biomass and cover crops were terminated. A pie-slice-shaped area measuring one-sixteenth of the plot was cut at ground level and removed from the plot to measure biomass of the cover crop. The biomass sample from each plot was divided into cover crop and weeds, dried to constant weight at 106°F and the dry weights were recorded. The biomass sampling procedure was designed to accurately measure the amount of cover crop biomass that was incorporated into each plot at termination, but it is likely not representative of field-scale cover crop production due to edge effects common in small plots. The remaining standing cover crop biomass was cut into short (~3 inch) pieces using a hedge trimmer. A small garden rototiller was used to incorporate the cover crop biomass into each plot. Soil within each plot was smoothed and packed with a shovel, then irrigated to promote the biofumigation process.

Statistical Analysis

A two-way analysis of variance (ANOVA) was used to test for the effects of variety and herbicide treatment on both cover crop and weed biomass.

Next Steps

When YNS begins to emerge in the spring of 2020, shoots will be counted in all plots to evaluate the effectiveness of the treatments. Due to the difficulty of establishing YNS during the first year of this study, YNS will be allowed to grow without competition during the spring and summer of 2020 to ensure establishment. Cover crop treatments will be repeated in the fall.

Results and Discussion

Cover crops were successfully established in the plots, and biomass production is shown in Table 1. Herbicide injury (curled leaves) was visible in one plot that received extra irrigation from a neighboring experiment. However, herbicide-treated plots had slightly, but not significantly, higher cover crop biomass than untreated plots, which suggests that the herbicide treatment did not negatively impact cover crop growth. Master mustard had significantly higher biomass production than Control radish ($P < 0.05$). It was not practical to measure belowground biomass, but observations of cover crop roots suggest that Control radish had higher belowground biomass production than Master mustard. No statistically significant differences were detected in weed biomass production between treatments.

Conclusions

This study was based on the idea that YNS can be suppressed through competition with another crop. The poor establishment of YNS when wheat was present demonstrates that competition with a cover crop has potential to be a successful YNS control strategy.

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References

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Table 1. Mean ± standard deviation (n = 6) cover crop and weed biomass (reported on a dry matter basis) incorporated into plots in the cover crop–yellow nutsedge control study, Malheur Experiment Station, Oregon State University, Ontario, OR, 2019.

Cover crop	Herbicide	Cover crop biomass (g/plot)	Weed biomass (g/plot)
Master mustard	no	1788 ± 263	61 ± 48
Control radish	no	1248 ± 407	201 ± 347[1]
Master mustard	yes	1834 ± 368	60 ± 71
Control radish	yes	1395 ± 337	36 ± 34
ANOVA[2]			
Cover crop		*	NS
Herbicide		NS	NS
Cover crop x Herbicide		NS	NS

[1] Includes one outlier that had more than five times higher weed biomass than the second highest biomass measurement in the study. When this outlier is removed, the weed biomass of this treatment is similar to other treatments.

[2] Significance codes: * = P < 0.05, NS = P > 0.05