Development of a Granular Herbicide Spot Applicator for Management of Hair Fescue (*Festuca filiformis*) in Wild Blueberry (*Vaccinium angustifolium* Ait.)

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Introduction

Hair fescue (*festuca filiformis*) is currently the pest of greatest concern for the wild blueberry (wbb) industry

This economically destructive weed has increased in field frequency from 7% in 2001 to 68% in 2019

Afflicted fields see an average uniformity of 25%

Fig. 1: Blueberry field showing significant hair fescue infestation

Hair fescue can rapidly spread as a result of:

- Single tufts producing up to 3000 seeds
- Seeds readily breaking from the panicle and lacking primary dormancy
- Multiple passes of agricultural equipment per growth cycle
- Multiple seed drops per year per plant
- Kerb™ SC being the only widely employed herbicide while remaining expensive and difficult to attain

Problem and Objectives

- The Problem: Casoron® G4 has shown an ability to adequately control hair fescue, though there is currently no way to apply it cost effectively due to its significant broadcast application cost
- Objective 1: Develop an application system which accommodates spot-specific treatment of hair fescue using Casoron® G4
- Objective 2: Compare the effectiveness of both prescription map and machine vision-based decision systems

Design

The basis of this design is a Valmar 1255 TR pull type pneumatic granular applicator

Various modifications were made to the applicator to accommodate spot treatment including:

- Addition of hosing to allow the return of unapplied product back to the hopper
- Modification of the blower fan to increase mean nozzle air speed from 7.0 m s^{-1} to 7.9 m s^{-1}
- Development of custom Y-valves for product application or return to the hopper
- Development of a custom control system for valve actuation using bistable rotary solenoids

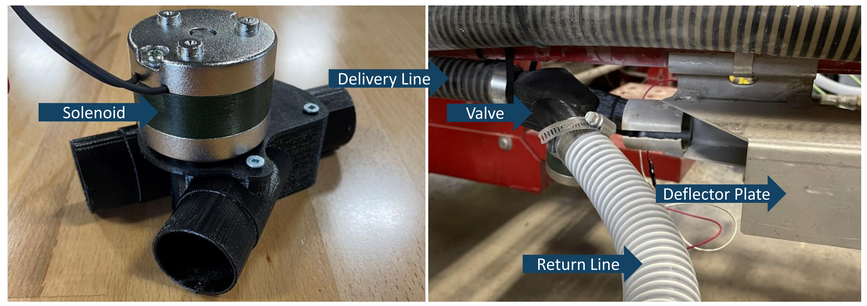

Fig. 2: Image of custom valve and solenoid (left) and mounted configuration of the valve (right)

Prescription maps were developed from aerial multispectral imagery taken from a drone

Prescription maps were loaded onto a John Deere RC2000 paired with a Starfire 6000 GNSS receiver

Fig. 3: Current applicator configuration during field testing, May 2022

Field Testing

Glue traps were placed within swaths in 10 target and 10 non-target locations per swath as defined by the presence of hair fescue in the field

A pass with the applicator was made at 1.34 m s^{-1} while the rate controller actuated the valves according to the prescription map

Glue traps were defined as hit or missed by the presence of granules stuck to the traps

Results and Conclusions

Metric	Ratio
Sensitivity	0.92
Specificity	0.86
Precision	0.86
Accuracy	0.89

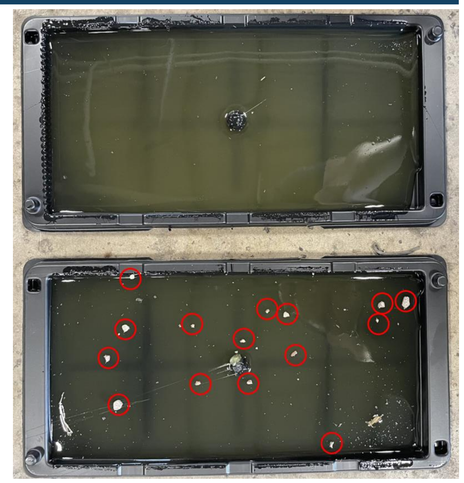

Fig. 4: Performance metrics of the applicator (left) along with examples of a true negative trap (top right) and true positive trap (bottom right)

Overall the system performed well and there is reason to believe that the valve design was the key contributor to the small amount of error

Moving forward, valves will be redesigned to account for the jamming experienced during testing

A neural network based machine vision system for identifying hair fescue in real time has already been developed and will be incorporated with the applicator

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