EVALUATION OF FOLIAR CALCIUM AND FUNGICIDE FOR SURVIVAL OF CORN LILY *(VERATRUM CALIFORNICUM)* SEEDLINGS FROM FIVE SOURCES

Clinton C. Shock, Erik B. G. Feibert, and Lamont D. Saunders, Malheur Experiment Station, Oregon State University, Ontario, OR, 2013

Introduction

Corn lily *(Veratrum californicum)* is native to higher elevations of the Intermountain West. Corn lily is of interest because it has the potential to provide pharmaceutical precursors for use against cancer.

A consistently successful establishment system is needed if corn lily seed is to be planted in intensive nurseries for transplanting to commercial fields. Although skepticism has been voiced about the possibility of establishing corn lily from seed due to the near absence of seedlings observed in nature, direct mechanical planting of seed could be a practical option to start plantings. Fall planting should be preferred, because the seed requires a period of cold to break dormancy (vernalization). Research at Malheur Experiment Station has shown that successful emergence of fall-planted corn lily seed is possible with surface planting and the use of row cover (Shock et al. 2012, 2014). Postemergence seedling survival has been inconsistent. Seedling survival has been hindered by leaf yellowing and necrosis, which resemble calcium deficiency and fungal pathogenicity.

This trial tested foliar applications of calcium, fungicide, and gibberellic acid for improving survival of corn lily seedlings from five sources of seed planted at McCall, Idaho.

Materials and Methods

Seed weights for five seed sources of corn lily were determined (Table 1). The seed weights were used to make seed packets containing approximately 600 seeds each. The trial was planted manually on November 9, 2010 at McCall, Idaho. Seed from the five sources was planted in a randomized complete block design with four replicates. Each source plot consisted of four split plots planted with 600 seeds. Each split plot consisted of 2 30-inch beds 5 ft long. Drip tape (Aqua Traxx EA 508 1222) was installed before planting in the center of each bed at 1-inch depth. Seed was planted on the soil surface in two rows on each bed. After planting, sawdust was applied in a narrow band over the seed row at 0.26 oz/ft of row (558 lb/acre). Following planting and sawdust applications, the beds were covered with row cover. The row cover (N-sulate, DeWitt Co., Inc., Sikeston, MO) covered four rows (two beds) and was applied with a mechanical plastic mulch layer.

Table 1. Seed weight and percent live seed for seed sources of corn lily (*Veratrum californicum*) planted in November of 2010 at McCall, ID. Malheur Experiment Station, Oregon State University, Ontario, OR.

Source	Seed weight		Tetrazolium test
	seeds/g	seeds/lb	% viable seed
Heber National Forest, UT	132	60,088	92
Big Lookout Mt., OR	357	162,143	81
Lone Rock Valley, CA	262	118,779	95
Muldoon Canyon, UT	363	164,758	80
Fairfield, ID	227	102,974	95

Tetrazolium tests were conducted to determine corn lily seed viability from the five seed sources (Table 1). The tetrazolium results were used to correct the raw emergence data to the percent emergence of viable seed.

In the spring of 2011 the row cover was removed. The four split plots within each seed source plot were randomly assigned to one of four treatments (Table 2). Treatment 2 was a foliar application of calcium (InCa, Plant Impact, Preston, UK, 1 oz/gal water). Treatment 3 added fungicide (Dithane® DF, 1.3 oz/gal water) to the calcium application. Treatment 4 was the same as treatment 3 except for the addition of a single application of gibberellic acid (Progibb, Valent Biosciences, Libertyville, IL, 3 g/gal water) at the first treatment application each year. In 2011, the treatments were applied on June 3 using a backpack sprayer. In 2012, the treatments were applied on June 6, June 13, and June 28. The field was hand weeded in 2011 and 2012. Stand counts were made on May 18, 2012.

The field was irrigated automatically in 2011 and 2012 to maintain the soil water tension (SWT) in the root zone below 10 cb. Soil water tension was measured with five granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrometer Co., Riverside, CA) installed at 8-inch depth in the center of the bed. The fields at each site were irrigated automatically to maintain the SWT in the root zone below 10 cb as described by Shock et al. (2013). The GMS had been previously calibrated to SWT (Shock 2003). The GMS were connected to a datalogger via multiplexers (AM 410 multiplexer, Campbell Scientific, Logan, UT). The datalogger read the sensors and recorded the SWT every hour. The datalogger made irrigation decisions every 12 hours based on the average SWT. The irrigations were controlled by the datalogger using a controller (SDM CD16AC controller, Campbell Scientific, Logan, UT) connected to a solenoid valve.

Data were analyzed using analysis of variance (General Linear Models Procedure, NCSS, Kaysville, UT). Means separation was determined using a protected Fisher's least significant difference test at the 5% probability level, LSD (0.05).

Fertilization procedures

The trial was conducted in a field of loamy sand (85% sand, 5% silt, and 10% clay). Analysis of a soil sample taken in the fall of 2009 showed a pH of 6.3, 1.63% organic matter, 17 ppm phosphorus, 304 ppm potassium (K), 7 ppm sulfate, 846 ppm calcium (Ca), 102 ppm magnesium (Mg), 21 ppm sodium, 0.8 ppm zinc (Zn), 0.3 ppm copper (Cu), 6 ppm manganese (Mn), 57 ppm iron, and 0.2 ppm boron (B). On May 20, 2010, 200 lb/acre of gypsum, 100 lb nitrogen (N)/acre as urea, 40 lb K/acre as K-Mag, 2.4 lb of Zn/acre as zinc sulfate, 2.4 lb Cu/acre as copper sulfate, and 1.2 lb B/acre were broadcast. On June 21, 2011, 200 lb/acre of gypsum, 100 lb N/acre as urea, 40 lb K/acre as K-Mag, 2.4 lb of Zn/acre as zinc sulfate, 2.4 lb Cu/acre as copper sulfate, and 1.2 lb B/acre were broadcast. On June 8, 2011, gypsum at 1,600 lb/acre was applied in a band over each drip tape on each bed. On May 31, 2012, 20 lb N/acre was injected through the drip tape. On May 1, 2012, 2000 lb/acre of gypsum, 10 lb Cu/acre, and 100 lb Mg/acre were broadcast.

Results and Discussion

The results demonstrate that it is feasible to establish a corn lily seedling nursery directly from seed.

Seed origin resulted in significant differences in stand. Seed from Lone Rock Valley, California and from Fairfield, Idaho produced the greatest stands. Second-year stand establishment for seed from Lone Rock Valley and from Fairfield was successful, averaging 73 and 68%, respectively. Seed from Heber, Utah produced the lowest stand. The environments at Heber and Muldoon, Utah have a much higher elevation and have a longer winter than at McCall. The elevation and winter duration at Fairfield, Big Lookout Mt., Oregon and Lone Rock Valley are more comparable to McCall. These results suggest that seedling nurseries should be planted in environments similar to the seed sources.

There was no significant difference in second year stand between the Ca and fungicide treatments.

References

Shock, C.C. 2003. Soil water potential measurement by granular matrix sensors. Pages 899-903 *in* B.A. Stewart and T.A. Howell (eds). The Encyclopedia of Water Science. Marcel Dekker.

Shock, C.C., E.B.G. Feibert, C.A. Parris, and L.D. Saunders. 2012. Direct seeding strategies for nursery establishment of corn lily (*Veratrum californicum*). Oregon State University, Malheur Experiment Station Annual Report 2011, Department of Crop and Soil Science Ext/CrS 141183-160.

Shock, C.C., E.B.G. Feibert, C.A. Parris, and L.D. Saunders. 2014. Direct seeding strategies for nursery establishment of corn lily. Oregon State University, Malheur Experiment Station Annual Report 2013, Department of Crop and Soil Science Ext/CrS 149:206-214.

Shock, C.C., F.X. Wang, R.J. Flock, E.B.G. Feibert, C.A. Shock, A.B. Pereira, and L.B. Jensen. 2013. Irrigation monitoring using soil water tension. Sustainable Agriculture Techniques, Oregon State University Extension Service. EM 8900 10p. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/37569/em8900.pdf

Table 2. Percent stand on May 18, 2012 of *Veratrum californicum* seed planted in fall of 2010 for seedlings submitted to three foliar applied treatments. Malheur Experiment Station, Oregon State University.

		Veratrum seed source					
#	Treatment	Heber	Big Lookout Mt.	Lone Rock Valley	Muldoon	Fairfield	Average
		% stand					
1	Check	5.1	40.2	69.5	30.6	62.3	43.5
2	Calcium	2.4	35.6	79.2	31.3	73.7	46.7
3	Calcium + fungicide	3.1	35.1	73.6	26.4	72.3	44.2
4	Calcium + fungicide + gibberellic acid	7.5	44.0	68.6	28.6	65.2	44.6
	Average	4.5	38.7	72.7	29.2	68.4	44.7
	LSD (0.05) Treatment						NS
	LSD (0.05) Selection						7.4
	LSD (0.05) Trt X Sel.						NS