Evaluation of seed treatments in hulless pumpkin seed production

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Introduction

Styrian hulless seed pumpkin has been cultivated for many generations in Eastern Europe. Pumpkin seeds have high nutritional value: high protein content, zinc, vitamin E, and unsaturated fatty acids (Bavec et al. 2007, Beavers et al. 2008). Hulless pumpkin seeds offer an additional interest as they are easier to process and make oil extraction simpler. While consumers are concerned about food quality and nutritional value, the production of this type of pumpkin for snack and processing markets offers an interesting avenue for crop diversification on organic field crop farms and for additional revenue on small organic community supported farms (CSA).

Previous work (Boisclair et al. 2013) has shown that hulless pumpkinseed production from transplants has a good potential for the diversification of organic farms in Québec. There is also a growing interest from buyers to provide local supply. However, seedlings are very sensitive to soilborne pathogens that cause damping-off and there is actually no efficient and organic seed treatment available. In order to favor hulless pumpkinseed production on large scale, sowing problems have to be looked at.

Objectives

The main objectives of this study were to :

- to evaluate in growth chamber three approaches to control damping-off in Styrian pumpkin seedlings: coating with copper oxychloride Copper Spray®), priming seeds with or without biological fungicides coating and pre-germinating seeds with or without solutions of biological fungicides;
- to compare sowing Styrian pumpkin with seeds coated with copper oxychloride, pregerminated seeds and transplanting in field situation.

Material and Methods

Experimental site: Platform for Innovation in Organic Agriculture (Saint-Bruno-de-Montarville, Que.), 2014 and 2015.

Soil type: sandy loam
Cultivar: *Cucurbita pepo* cv Styriaca

Experimental Design: Randomized Complete Block Design (RCBD)

Table 1. Description of growth chamber and field experiments.

Growth chamber experiments experimental unit: 25 to 36 seedlings			**Field experiments** experimental unit : 3 rows of 12 plants	
Efficacy + phytotoxicity tests		Efficacy tests		
Copper chloride (Copper Spray®)[1]	Seed priming with/without coating with biofungicides[2]	Pregerminated seeds with/without biofungicides[2]	Copper chloride (Copper Spray®)[1] efficacy	Comparison of copper chloride coating, pregerminated seeds and transplantation
DATA[3]: date and percentage of germination, growth stage, fresh and dry biomass 2 weeks after sowing				DATA : striped cucumber beetle pressure[4], defoliation[4], bacterial wilt (BW) incidence and mortality, seed yield

[1] Treatments: 50% minimum dose, minimum dose, maximum dose, 2x minimum dose, 2x maximum dose, control (water and kaolin), control (water only), untreated seeds, untreated seeds in potting soil.
[2] Biofungicides tested: Actinovate® (*Streptomyces lydicus*), Serenade® Max (*Bacillus subtilis*), Mycostop® (*Streptomyces griseoviridis*) et Rootshield® (*Trichoderma harzianum*).
[3] Only summary results from growth chamber experiments are presented (Table 1).
[4] Data not presented.

Results

Growth chamber experiments

Table 2. Summary of the results of phytotoxicity and efficacy tests done in growth chamber experiments, 2014 and 2015.

	Phytotoxicity tests	Efficacy tests
Copper chloride (Copper Spray®)	No significant effect on dry biomass and germination percentage	▪ percentage of germination varied between doses of copper oxychloride, from 3 to 22.0% ▪ no germination occurred in the untreated control.
Seed priming with/without coating with biofungicides	No significant effect on dry biomass and germination percentage	▪ no germination
Pregerminated seeds with/without biofungicides*	NA	▪ average percentage of germination of 72%.

Field experiments

Table 3. Effect of five doses of Copper Spray® (copper oxychloride) used as seed coating combined with Surround® (kaolin) on percentage germination of field pumpkin seedlings, 2014 and 2015.

Treatment Copper Spray® doses	2014 % germination (n=36) Mean % germination	2014 Confidence interval (95%) Lower limit	2014 Upper limit	2014 Contrast	2015 % germination (n=36) Mean % germination	2015 Confidence interval (95%) Lower limit	2015 Upper limit	2015 Contrast
50% minimum dose OCC[a]	31	-1.28	-0.31	c	6	-3.51	-1.93	bc
minimum dose (500 g/ 100 kg of seeds)[a]	36	-1.05	-0.10	bc	5	-3.68	-2.02	cd
maximum dose (750 g/ 100 kg of seeds)[a]	53	-0.35	0.58	a	10	-2.81	-1.51	abc
2x minimum dose[a]	51	-0.41	0.52	a	17	-2.13	-1.01	a
2x maximum dose[a]	53	-0.32	0.60	a	13	-2.50	-1.29	ab
control (water and kaolin)[ab]	0	Ø	Ø	Ø	0	Ø	Ø	Ø
control (water only)[ab]	0	Ø	Ø	Ø	0	Ø	Ø	Ø
untreated seeds[ab]	0	Ø	Ø	Ø	0	Ø	Ø	Ø
	Type III tests for fixed effects (Pr > F): 0.0055				Type III tests for fixed effects (Pr > F): 0.0055			

[a] These treatments were applied while some pathogens were present in the field. The average weight in one column followed by the same letter are not significantly different (α = 0.05).

Table 4. Percentage of mortality and development from sowing and transplantation of pumpkin (*Cucurbita pepo* cv Styriaca), 2015.

Treatment	Percentage of mortality	Growth stages 5-leaf	Flowering	Fruit set
Transplants	10	26/06	09/07	30/07
Copper oxychloride treated seeds	89	09/07	23/07	13/08
Pregerminated seeds	36	09/07	23/07	13/08

Table 5. First observation of bacterial wilt (BW) symptoms and percentage of plants in each coded class of BW obtained with a multinomial logit regression model, 2015.

Treatment	First observation of BW symptoms	Percentage of plants with ordered values for BW incidence 0[a]	1[b]	2[c]
Transplants	July 23	76.74	20.93	2.33
Copper oxychloride treated seeds	July 30	53.33	40.00	6.67
Pregerminated seeds	July 9	76.92	19.78	3.30

Type III tests for fixed effects : Pr > F = 0.2064

Contrasts	Odds ratio*	Pr > |t|
Transplants vs copper oxychloride treated seeds	2.6019**	0.0858
Transplants vs pregerminated seeds	0.9948	0.9873
Copper oxychloride treated seeds vs pregerminated seeds	0.3823	0.0932

[a] healthy plant, [b] plant with BW symptoms, [c] dead plant from BW. Treatment effect is not significant (α = 0.05).
* Odds ratios are used for treatment comparisons.
** The odds for transplants being in the lower coded class of BW (less bacterial damage) is 2.6 times the odds for copper oxychloride treated seeds.

Table 6. Mean fruit and seed yields, average pumpkin and seed weight, with standard errors in parentheses, probability values for F-tests and t-tests for contrasts.

Treatment	Marketable pumpkin yield	Average pumpkin weight	Seed weight	Seed yield
	kg/ha	kg	g/1000 seeds	kg/ha
Transplants	59 548 (6 700)	4.260 (0.239)	198.5 (6.4)	1 062 (88)
Copper oxychloride treated seeds	18 250 (6 700)	5.561 (0.438)	206.2 (12.0)	234 (88)
Pregerminated seeds	35 046 (6 700)	4.727 (0.289)	208.5 (7.6)	574 (88)
P - values				
F test for treatment effect	0.0063	0.0839	0.622	0.0007
Contrasts (P >|t|)				
Transplants vs copper oxychloride treated seeds	0.0022	0.001	0.5973	0.0002
Transplants vs pregerminated seeds	0.023	<0.0001	0.3888	0.0039
Copper oxychloride treated seeds vs pregerminated seeds	0.0829	<0.0001	0.8792	0.0194

Conclusions

- Growth chamber experiments showed that the best strategy to increase seed germination was the use of pregerminated seeds.
- No phytotoxicity symptoms were observed for all trials conducted in growth chamber experiments.
- Seeds coated with different doses of oxychloride copper and sown in the field had mean germination percentage varying between 31% and 53% in 2014, and 6% and 17% in 2015.
- Since the seedling emergence was low and uneven in both seeded treatments of 2015 field experiment, good mechanical weeding was not possible in these treatments due to the heterogeneousness of plants.
- The incidence of bacterial wilt and seed yield were 46.67, 23.08, and 23.26% and 234, 574 and 1062 kg/ha in copper oxychloride treated seeds, pre-germinated seeds and transplants treatments respectively.
- Lack of maturity of the seeded plants could also be a concern in case of early autumnal frost.

References

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