Comparing Culture & Planting Times for New Cultivar Releases of Rutgers Scarlet Lettuce®

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Abstract

Two new, red lettuce cultivars with high levels of anti-oxidants were trialed in New Jersey. Growth assessments compared spring versus fall planting times, plasticulture versus bare ground culture, and field grown versus greenhouse production. Pelleted seed and transplants of the Rutgers red leaf and red romaine cultivars termed Rutgers Scarlet Lettuce (RSL) were planted in replicated plots 12 inches apart in double rows on 28 inch beds with trickle irrigation.

Spring season germination of field sown seed on white plastic averaged 63.3% for RSL leaf lettuce and 65.0% for RSL romaine. On black plastic, RSL leaf cultivar averaged 42.5% germination and RSL romaine 35.0%. Fall germination on both black and white plastic trended lower at 30.0% and 25.0% for RSL leaf and 55.0% and 55.0% for RSL romaine, respectively. Seed germination for greenhouse transplants in 50 cell trays was 96% or better in both spring and fall plantings which was significantly better at P> 0.05 than all field plasticulture and bare-ground treatments. This result was largely due to differences in soil temperature of a constant 80^0 F. from radiant floor heat with indoor cultivation vs. a variable field soil range of 48.5-69.6 ^{0} F. in the first 21 days after seeding.

Wet head weight from spring bareground trials in 2015 for RSL leaf and romaine averaged 232.6 and 246.0 grams, respectively. Wet head weight for RSL leaf lettuce in plasticulture averaged 138 grams compared to a standard red leaf cultivar Red Sails average of 195 grams. RSL romaine in plasticulture had an average head weight of 110 grams while standard green romaine was 204.1 grams. 2016 spring trials were slightly better. Other comparative cultivars generally grew larger as a semi-red romaine cultivar and red leaf lettuces as Ruby Red and Tasty Red. There was no significant difference in germination, growth or yield between plasticulture colors. Late season bolting and a range of bitterness was evaluated in both the spring and fall field plantings of RSL lettuces. Both spring and fall planting seasons were characterized with periods of rapid air temperature changes from low 50^0's F. to high 90's^0 F. In eight separate plantings in three hydroponic operations with controlled climate, the quality of RSL lettuces were superior to field production with little to no bolting or bitterness.

Introduction

Rutgers University research by Dr. Ilya Raskin has recently produced new and nutritionally improved lettuce cultivars – a red leaf and a red romaine type. Lettuce health benefits are due to polyphenols, vitamins, carotenoids and fiber. These cultivars were developed through somaclonal variation and tissue culture; they are not genetically modified (GMO). Field testing at NJ extension centers, grower farms, home gardens and greenhouses assessed commercial utility of these lettuces in terms of germination, growth, culture, color, yield, pest management and nutritional composition.

Project Objectives

1. Determine germination of pelleted lettuce seed
2. Measure crop growth in spring and fall seasons in NJ field trials
3. Compare crop yields vs. commercial standards in NJ field trials
4. Compare growth on white vs. black plasticulture
5. Assess growth in various greenhouse methods

Materials & Methods

Site description - Soil pH was generally between 6.0 and 6.5 in sandy loam soils. No residual herbicide programs were used for these leafy greens.100 lbs./A of 15-15-15 fertilizer was incorporated. Production method – Pelleted lettuce seed from Shamrock Seed Company (Figure 1) was used in raised beds with double row planting with black or white plastic mulch and drip irrigation (Figure 2) for direct seeding and greenhouse transplant production. Four plasticulture beds of 24 inches width on 8 foot centers with trickle irrigation down the center compared treatments at the Cream Ridge site. Standard double row on either side of the drip tape with linear spacing 12 inches apart was used for both direct seeding and transplants. Seeds were planted approximately ¼ inch deep. Cultivation was used in the walkways for weed control and hand-weeding around the plant holes. Herbicides were not incorporated under the black or white plastic.

Rutgers Professors Develop Superfood

Dr. Diana Cheng, left, and Dr. Natash Pogrebnyak work on developing a high-polyphenol lettuce worthy of superfood status.

NEW BRUNSWICK, N.J.— Blueberries are considered the gold standard of superfoods due to their high levels of polyphenols, beneficial compounds shown to protect against diabetes, cardiovascular disease, memory loss, inflammation and cancer. However, this seasonal fruit, often priced at a premium, is high in sugar content, requiring limited consumption by people on restrictive diets.

A new superfood that's both low in sugar and available year round and exceeds the high polyphenol content of blueberries hit the market in October. This high polyphenol lettuce has been named Rutgers Scarlet Lettuce (RSL) - a tribute to Rutgers' school mascot and color, the Rutgers Scarlet Knights, and is the brainchild of Rutgers Distinguished Professor in Plant Biology Ilya Raskin at the School of Environmental and Biological Sciences.

Raskin started with red leaf lettuce with the highest polyphenol content and boosted it. Using a non-transgenic—non-GMO—process of tissue culture that replicates plant cells in a petri dish, he developed a deep burgundy-red lettuce that has elevated levels of polyphenols, two to three times that of blueberries, as well as other beneficial nutrients.

"Lettuce is one of the most widely consumed vegetables after potatoes," said Raskin. "This adds functionality to something that is not known for being good or bad."

Rutgers Scarlet Lettuce is the first lettuce worthy of superfood status. It is exceptionally high in antioxidants in addition to its being low in calories and high in fiber, as well as its regular benefits of vitamins and minerals. In addition, it has a low glycemic index, preventing spikes in blood sugar that foods high in carbohydrates or sugars, such as fruits and berries, can cause. These benefits have been reported in the scientific journals *PLOS ONE* and *Nutrition*.

To introduce Rutgers Scarlet Lettuce to the market, the university has patented and licensed it to Natrinsoth LLC, a Rutgers spin-off company that specializes in enhancing phytoactive compounds in foods. Since product businesses are not required (Cont. on pg. 18)

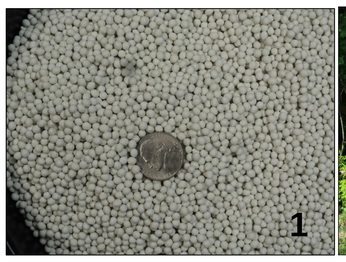
Rutgers Distinguished Professor Ilya Raskin and staff in Rutgers lab analyzing polyphenol content

White Plasticulture						
Jul 7 2016	Variety	Temp	Moisture	Height	Width	Head Wt.
1A	RSL leaf	77.9	9.0	10	12	312.7
1B	RSL leaf	79.5	9.0	19	12	251.4
2A	RSL romaine	78.4	9.0	16	11	252.5
2B	RSL romaine	78.4	6.5	13	11	274.5
3A	Red Sails	78.4	7.6	11	13	261.6
3B	Red Sails	78.2	6.0	13	14	486.1
4A	Red Romaine	78.6	7.0	29	17	373.2
4B	Red Romaine	78.2	9.0	31	17	394.2
		78.5	7.9	17.8	13.4	325.8

Black Plasticulture						
Jul 7 2016	Variety	Temp	Moisture	Height	Width	Head Wt.
1C	RSL leaf	82.4	8	12	12	220.8
1D	RSL leaf	82.7	5.5	11	11	231.1
2C	RSL romaine	83.1	8	15	11	330.1
2D	RSL romaine	80.9	5	20	12	284.7
3C	Red Sails	80.1	10	16	13	487.7
3D	Red Sails	79.8	7	12	13	893.4
4C	Red Romaine	80.2	9	23	17	713.8
4D	Red Romaine	82.2	9	23	14	764.2
		81.0	7.3	17.5	13.3	490.7

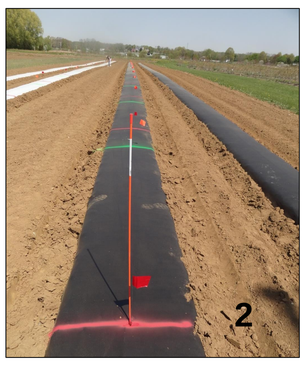
Leaf Lettuce % Bolting	
Red Hot	84.0
Tamarindo	0
Red Mist	88.5
Red Magma	30.9
Shanghai Red	9.4
Vulcan	40.7
Rouxai	0
Cherokee	0
Oscarde	56.0
Rutgers Red Leaf	78.9
New Red Fire	0
Red Express	2.6

Romaine % Bolting	
Calshot	84.0
Pomegranate Crunch	0
Rutgers Red Romaine	92.0
Red Cash	26.9
Annapolis	84.4
Red Rosie	100
Thurinus	2.0

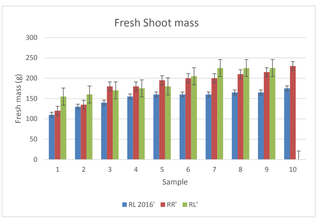


Rutgers Scarlet Lettuce seed – Pelleted by Sharmrock Seed Co.[1]

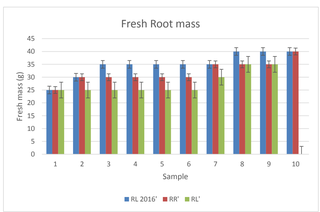
RSL transplants – 50 x per flat Kube Pak Greenhouses



Plot size and set-up of bare ground, white plasticulture and black plasticulture [2] replications

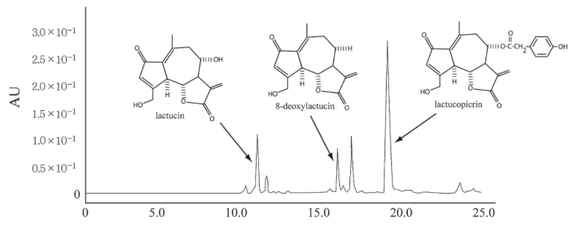


		RL 2016	RR	RL
Dry mass	Average	9.571	9.206	10.067
	Std Dev	1.263	2.373	1.952
Fresh mass	Average	152	186.5	191.111
	Std Dev	19.607	34.725	29.023



		RL 2016	RR	RL
Dry mass	Average	2.162	1.87	1.807
	Std Dev	0.199	0.206	0.253
Fresh mass	Average	35	32	27.778
	Std Dev	4.714	4.216	4.410

Fresh root & shoot mass growth of three Rutgers Scarlet cultivars – red leaf 2015, red leaf 2016 and red romaine. UA hydroponics



Bitterness Compounds–Sesquiterpene Lactones + BSL's HortScience – Yang, Kays, Lee & Park

Myles Lewis & staff Univ. of Arizona Hydroponics

RSL romaine growth in RAFT system Univ. of Arizona Hydroponics

Edible Garden greenhouse production Belvidere, NJ

Aeroponic Production 1 wk. growth, Freehold, NJ

RSL growth at 5 weeks – Beyond Organics, Freehold, NJ

RSL root development in hydroponics & aeroponics

RSL Comments and Conclusions

1. Field research and demonstration trials in 2015 and 2016 showed erratic performance primarily due to atypical and variable weather.
2. Greenhouse trials had consistently good growth in soil containers, hydroponics and aeroponics. Performance had much less variability in root zone and air temperature, humidity and light.
3. Bolting and bitterness often affected RSL cultivars in spring and fall field plantings as well as several commercial comparisons.
4. Soil temperature appears to be a key factor when exceeding 75° F. in bare ground or plasticulture.
5. Additional laboratory analysis of phytonutrient is being conducted to determine potential nutritional benefits in field and greenhouse production.

Acknowledgements

Photo Credits – Vivian Quinn, Bill Sciarappa, Gene Giacomelli & Myles Lewis