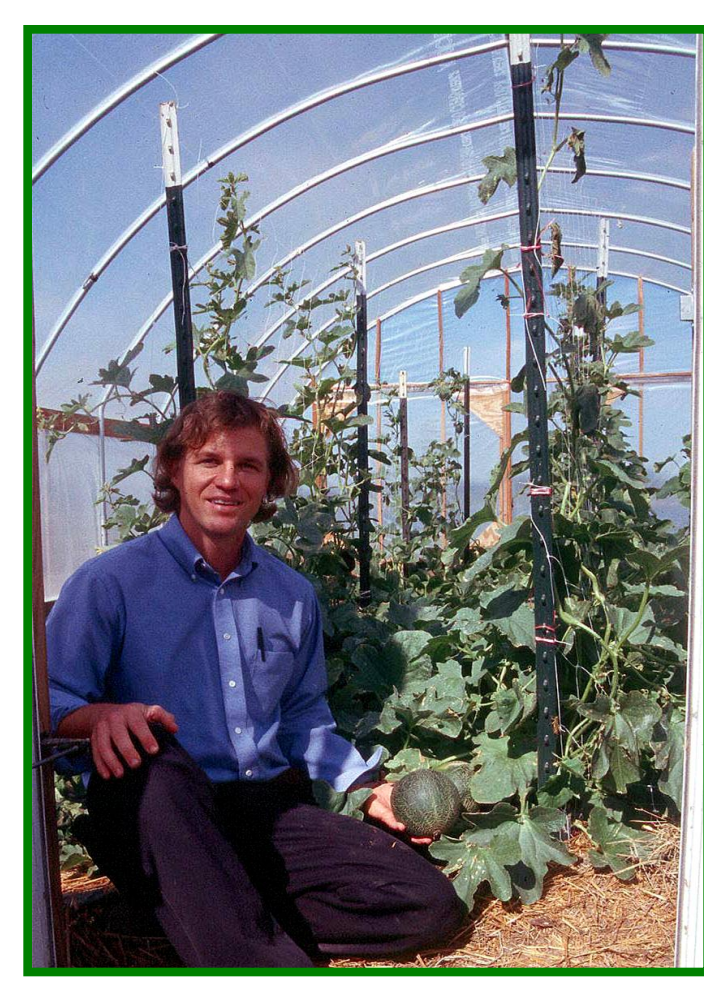


Evaluation of Head Lettuce (*Lactuca sativa* L.) and Leafy Greens for Year-Round Institution Markets in West Virginia



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ABSTRACT

Lettuce (*Lactuca sativa* L.) is a leafy green vegetable which can be grown year-round in high tunnels in West Virginia. The summer growing season at higher elevation areas provides a suitable microclimate for warm season head lettuce production. The high tunnel also provides sufficient low temperature protection during the winter for extended season production. Like many U.S. states, there has been a tremendous expansion of high tunnel production in West Virginia of specialty crops within the last ten years. High tunnels provide tremendous capacity for wholesale marketing of lettuces and other leafy greens to large volume, institutional buyers such as schools and hospitals. From 2014-2018 ≈ 70 lettuce and 25 spinach cultivars have been critically evaluated for stress tolerance, quality, shelf life, disease tolerance and marketable yield within high tunnels. From these evaluations, select cultivars for year-round production in West Virginia have been identified.

INTRODUCTION

Lettuce (*Lactuca sativa*) is the second most widely grown crop within high tunnels in the United States behind tomatoes. Given a base temperature of approximately 4°C, lettuce can be grown in both heated and unheated high tunnel structures. Bibb and romaine head lettuce are two popular head lettuces. Bibb lettuce or butterhead lettuce has loose, open heads with soft or tender leaves while romaine or cos has long, firm leaves with prominent midribs. Bibb lettuce is an excellent choice for expanded local production because it does not ship well over long distances. Romaine lettuce has a more vertical or upright growth and produces a very dense head of leaves. Both types of head lettuces can be harvested at the baby stage for specialty markets.

Spinach (*Spinacia oleracea*) is one of the most productive and adaptable leafy green vegetable crops which can be grown in high tunnels. Spinach is a cool season vegetable and can be established by either direct seeding or transplanting. The typical seeding window for spinach in a high tunnel in West Virginia is August through April. Spinach is extremely cold tolerant and is one of the most reliable deep winter vegetable crops in the high tunnel. Generally, spinach is not seeded in the summer since most cultivars will flower during the extended photoperiod.

There is tremendous opportunity for expanded production and marketing of specialty crops including leafy greens in the Eastern Panhandle region of West Virginia by using seasonal high and low tunnel structures. However, there is a deficit of technical information related to production, scheduling, postharvest handling, food safety, economics and marketing of specialty crops using protected environment structures such as high and low tunnels.

The objective of this project is to create an expanded capacity of information related to production, scheduling, economics, food safety and postharvest handling of select leafy greens in the Eastern Panhandle of West Virginia for institutional markets such as schools and hospitals.



MATERIALS and METHODS

Lettuce seed were acquired from several cooperating seed companies (Table 1). Lettuce was seeded as transplants in a 128 cell plug trays (T.O Plastics) in September 2017 and March 2018. Lettuce was planted as 4-week-old transplants within a single polyethylene layer high tunnel at the WVU Kearneysville Farm in October 2017 and March 2018. Each lettuce plug was spaced 30 cm apart in a 2- or 3-row, alternated bed arrangement on black plastic mulch. Spinach evaluations were seeded in a 4-row bed within a single layer high tunnel at the WVU Kearneysville Farm in early March 2017. The soil at this farm is a silt loam with a pH of 6.8. Prior to seeding, 200 g/m² of 5-4-3 Harmony® fertilizer was applied and tilled into the beds. The spinach was hand-seeded with each seed ≈2.5 cm apart in-row and 15 cm between rows. Each plot was 0.6 m². In addition, spinach was transplanted within a double-polyethylene layer high tunnel in Hardy County, WV in November 2016. The transplanted spinach was spaced 10 cm apart in a 4-row bed covered with black plastic mulch. Twenty varieties of spinach and 29 lettuce cultivars were evaluated for yield and quality. Two sequential harvests were made per spinach variety while the interior row of each lettuce plot was harvested once. The cut leaves and heads were sorted, and fresh weight recorded. In addition, color, flavor and overall quality were subjectively rated. Each variety was replicated in a randomized complete block design. Lettuce cultivars evaluated included:

Cultivar	Days to maturity	Seed vendor/source
Salanova Green Incised	50	Johnny's Seeds
Salanova Red Incised	52	Johnny's Seeds
Salanova Green Sweet Crisp	52	Johnny's Seeds
Salanova Red Sweet Crisp	54	Johnny's Seeds
Salanova Green Butterhead	55	Johnny's Seeds
Salanova Red Butterhead	60	Johnny's Seeds
Salanova Green Oakleaf	55	Johnny's Seeds
Salanova Red Oakleaf	60	Johnny's Seeds
Magenta	48	Johnny's Seeds
Dancine	43	Johnny's Seeds
Adriana	48	Johnny's Seeds
Nancy	52	Johnny's Seeds
Rex	50	Johnny's Seeds
Australe	49	Johnny's Seeds
Skyphos	47	Johnny's Seed; Seigers Seeds
Red Cross	48	Johnny's Seeds
Buttercunch	46	Johnny's Seeds/Fedco Seeds
Big Boston	50	Baker Creek Seeds
Bruno D'hiver	50	Baker Creek Seeds
Blonde Du Cazard	50	Baker Creek Seeds
Little Gem	50	Baker Creek Seeds
Sierra	50	Harris Seeds; Rupp
Nevada	48	Harris Seeds; Siegers Seeds; Rupp Seeds
Sangria	55	Harris Seeds
Amaze	60	Harris Seeds
Margarita	50	Rupp Seeds
Helvius	58	Johnny's Seeds
Coastal Star	58	Johnny's Seeds; Seigers Seeds; Rupp Seeds
Salvius	65	Osborne Seed
Pomegranate Crunch	50	Osborne Seeds
Breen	45	Osborne Seeds
Truchas	45	Osborne Seeds
Dov	60	High Mowing Seed
Tropicana	52	Johnny's Seeds
Starfighter	60	Osborne Seeds
Green Star	60	Osborne Seeds
Fossey	55	Osborne Seeds
Red Dog	60	Osborne Seeds
Red Mist	60	Osborne Seeds
Cantarix	60	Osborne Seeds
Red Baron	65	Osborne Seeds
Alkindus	60	Osborne Seeds
Dragoon	45	Osborne Seeds
Rhazes	42	Osborne Seeds
Triple Play	65	Osborne Seeds
Green Reef	50	Osborne Seeds
Starhawk	50	Osborne Seeds
Hampton	60	Osborne Seeds
Muir	50	Johnny's Seeds
Cherokee	50	Johnny's Seeds



RESULTS



Figure 3. Head lettuce cultivars with both heat and cold tolerance for extended season production in West Virginia were identified.

Table 2. Marketable yield and quality attributes of high tunnel warm season lettuce trials-2018.

Cultivar	Wt. head ⁻¹ (g)	Diameter (cm)	Color ^z	Quality ^y
Cantarix MT	185	22.9	4.9	4.9
EZ Tron	226	26.7	4.4	4.1
Fossey	187	24.2	4.9	4.9
Green Incised	222	23.7	4.7	4.9
Salanova®				
Green Oakleaf	257	24.4	5.0	5.0
Salanova®				
Green Reef	212	23.6	4.9	4.5
Green Sweet Crisp	363	27.2	4.9	4.5
Salanova®				
Magenta	313	27.1	5.0	4.9
Red Incised	187	25.9	4.8	4.8
Salanova®				
Red Sweet Crisp	129	20.1	3.5	4.0
Salanova®				
Red Tango Salanova®	134	22.6	4.7	3.8
Starhawk	359	23.3	4.9	4.9
Standard error _(0.05)	18	0.5	0.1	0.4

^zColor rating scale 1-5; 1=poor color; 5=excellent color ^yQuality rating scale: 1-5; 1=poor quality; 5=excellent quality

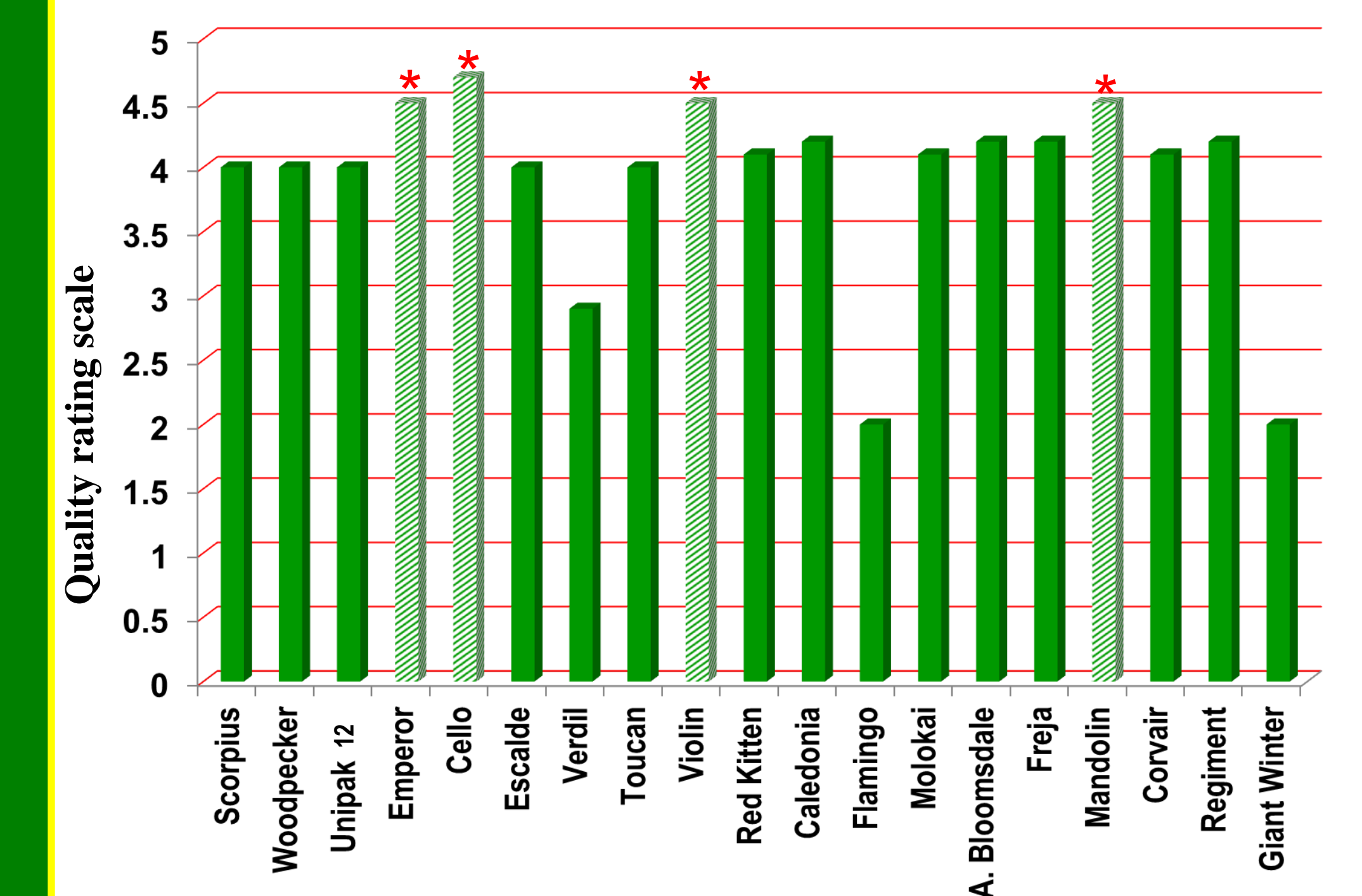
Stress tolerant cultivars:



RESULTS & DISCUSSION



Cultivar	Fresh wt. (g)/ft ²	Color ^z	Quality ^y	Leaf description
Abundant	38.6	4.8	4.8	Savoy leaf
Bloomsdale				
Caladonia	21.9	3.8	3.9	Smooth leaf
Cello	59.5	4.8	4.8	Savoy leaf
Corvair	52.0	4.7	4.6	Smooth leaf
Escalde	33.1	4.3	4.2	Semi-savoy leaf
Emperor	56.9	4.9	4.5	Savoy leaf
Freja	45.8	4.5	4.5	Smooth leaf
Molokai	36.6	4.6	4.6	Smooth leaf
Mandolin	59.3	4.7	4.5	Semi-savoy leaf
Red Kitten	38.3	4.4	4.5	Red vein and smooth leaf
Regiment	76.1	4.9	4.9	Savoy leaf
Scorpius	44.3	4.7	4.7	Smooth leaf and heat tolerant
Toucan	42.3	3.8	4.0	Smooth leaf
Unipack 12	80.4	4.8	4.6	Semi-savoy leaf
Verdil	43.2	4.0	4.0	Smooth leaf
Violin	64.2	4.8	4.8	Smooth leaf
Woodpecker	54.0	4.2	4.3	Semi-savoy leaf
Standard error	3.6	0.1	0.1	

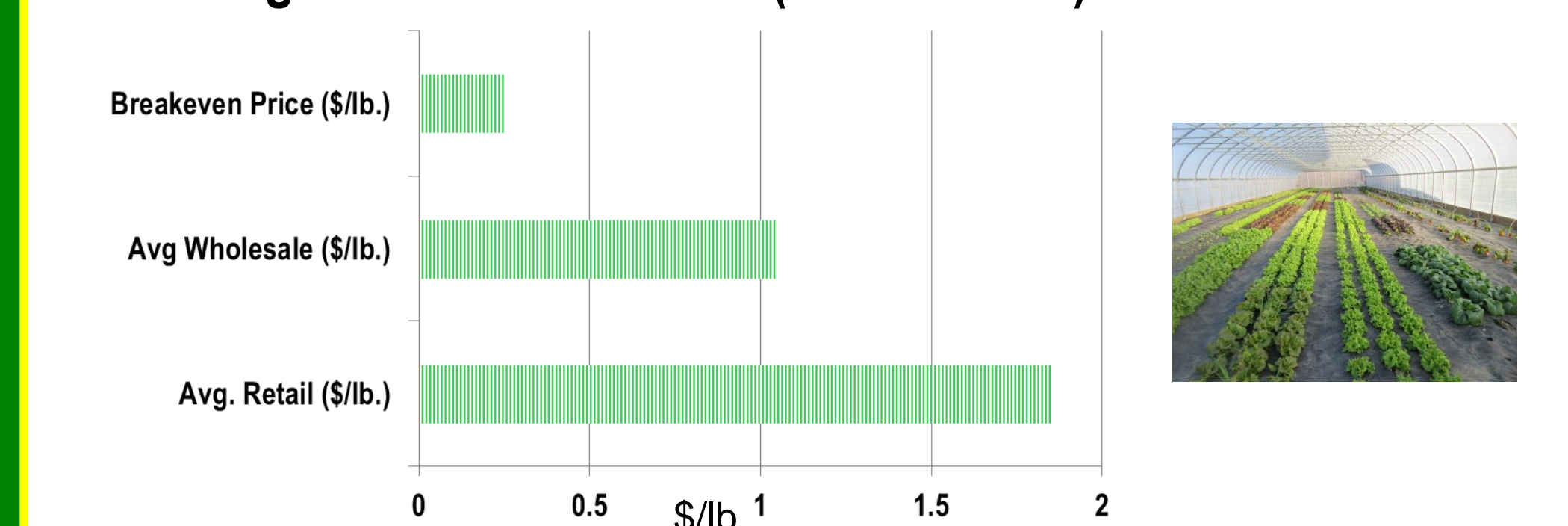


^yQuality rating scale: 1-5; 1=poor quality; 5=excellent quality

* Significant yield and quality

UniPack 12', 'Regiment', 'Violin', 'Cello' and 'Mandolin' were excellent spinach cultivars, exhibiting both high yield, quality and stress tolerance. 'Violin' was the highest yielding smooth leaf cultivar while 'Regiment' and 'Unipack 12' were the highest yielding savoy leaf cultivars. In late spring, 'Scorpius' was observed to have heat tolerance (i.e., no bolting) and thus, could possibly be grown as an early summer spinach in West Virginia for growers wishing to expand the market window. 'Regiment' and 'Emperor' were productive during the winter season 'Red Kitten' had distinct red veins and can be blended with traditional green spinach for a color mix.

Marketing and Profit Potential (head lettuce):



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