Journal of the American Pomological Society 72(2): 128-134 2018

Matted-Row Strawberry Cultivar Productivity in Missouri, 2013-14

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Additional index words: total yield, marketable yield, berry size, harvest dates

Abstract

Ten short-day strawberry cultivars were evaluated for productivity in southcentral Missouri. The production system was matted rows on a planting ridge formed along the row center, 20 cm high (8 in). The planting was established in 2012, cropped in 2013, renovated and cropped again in 2014. Rows were spaced at 1.2 meter (4 ft). Yearly means of all cultivars for total yield were 3.4 and 2.7 kg per linear m row in 2013 and 2014, respectively. The cultivars 'AC Wendy', AC Valley Sunset', 'Allstar', 'Annapolis'. 'Brunswick', 'Galleta' and 'Jewel' were most consistent and can be recommended to Missouri growers. Marketable yields of all cultivars were 74% and 67% in 2013 and 2014, respectively. Weighted averages for fruit of all cultivars were 11.9 g and 11.0 g in 2013 and 2014, respectively. Harvest season length of all cultivars averaged 21 days in 2013 and 16 days in 2014.

Introduction

Evaluating strawberry cultivars is an ongoing research project at the State Fruit Experiment Station of Missouri State University. Local growers are interested in the productivity of newer cultivars in comparison to older standards. The continental climate of southcentral Missouri is rated 6a in the USDA Plant Hardiness Zones with an average annual minimum of -23.3 to -20.6 °C (-10 to -5 °F). Average yearly rainfall is 102 to 114 cm (40 to 45 in). The trial location is at 37° 9' N latitude, 92° 16' longitude, with an elevation of 442 m (1,450 ft). Typical seasonal weather patterns are a wet spring, warm to hot summer temperatures with high humidity, and fluctuating winter temperatures with little or no snow cover. Matted-row strawberry production is adapted to zones 5 and lower using cultivars with good runner production (Hancock et al., 1997, Masiunas et al., 1991). Missouri growers have long used this system although the annual hill or 'plasticulture' system is becoming more accepted. Use of plastic mulch on raised beds in the annual hill system allows for good fruit appearance and ease of picking (Stevens et al., 2007). Nursery availability of runner tips in Sept. has made the annual hill system possible in Missouri although it can be unpredictable due to variability in fall and winter temperatures from year to year (Kaps et al., 2005). Matted-row strawberries have a lower investment and can be very productive if good weed control is practiced. This is accomplished using herbicides, mechanical tillage, and hand hoeing or weeding (Pritts, 2003; Pritts and Handley, 1998). Use of killed cover crop residue is another means of suppressing weeds in a modified (advanced) matted-row system (Black et al., 2002). Raised beds as used in the advanced matted-row and annual hill systems are preferred by harvest labor and pick-your-own (PYO) customers (Stevens et al., 2007). Past reports from the station summarized the productivity of older strawberry cultivars; three of which, 'Allstar', 'Annapolis' and 'Brunswick', were included in this trial (Kaps et al., 2003; Kaps et al., 1990; Kaps et al., 1987). Seven additional short-day strawberry cultivars were evaluated in this trial (Table 1).

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Table 1. Strawberry cultivars, origin, and bearing season planted at Mountain Grove, MO 2013-2014.

Cultivar	Year Introduced	Origin	Bearing Season
AC Wendy	2005	Nova Scotia, Canada	early
AC Valley Sunset	2006	Nova Scotia, Canada	late
Allstar	1981	Maryland, USDA	late
Annapolis	1984	Nova Scotia, Canada	early
Brunswick	2002	Nova Scotia, Canada	mid
Daroyal	2006	France	mid
Donna	2007	France	late
Galletta	2008	North Carolina	early
Jewel	1985	New York	mid
Record	2007	Italy	late

Materials and Methods

This strawberry cultivar trial was conducted at the State Fruit Experiment Station of Missouri State University at Mountain Grove, MO. The soil is a Wilderness series, gravelly silt loam soil with 3 to 8 percent slope. There is a fragipan at 40 to 70 cm (15 to 30 in) depth. While this layer can limit rooting depth for some tree fruit, it probably did not limit strawberry rooting. It can slow internal drainage during high rainfall periods. Permeability is moderate above the fragipan and very low in the pan. Water holding capacity of the soil is low because of the shallow depth to the fragipan. Soil reaction varies with depth from 6.5 to 4.5. Organic matter content also varies from 3.0 to 0.5%.

Tall fescue (*Festuca arundinacea* Shreb.) grass was the permanent ground cover in the years prior to planting establishment. A year prior to planting, a rotation of summer and winter cover crops was used to build soil organic matter and suppress weeds. The site was plowed and disced, and then summer and winter cover cropped with buckwheat (*Fagopyrum esculentum* Moench) and cereal rye (*Secale cereal* L.), respectively. The site was not fumigated because the ground had been out of strawberry production for six years. New ground not previously planted to strawberries or fallow and cover cropped ground usually does not require soil fumigation (Pritts, 2003; Pritts and Handley, 1998).

Soil was sampled from the planting sites and tested for nutrients. Nitrogen, phosphorus, potassium, and boron were applied at 90, 110, 105, and 4.5 kg per ha (80, 100, 95, and 4 lb per A), respectively. These were broadcast as dry fertilizer (boron sprayed as Solubor) and incorporated into the soil prior to planting. Rows were spaced at 1.2 meter (4 ft) with a planting ridge formed along the row center with a tractor drawn cultivator, 20 cm high (8 in).

The strawberry cultivars, year introduced, origin, and bearing season are listed in Table 1. The experiment was a randomized complete block with four replications. Each replicate consisted of twelve plants per 4 m (13 ft) of row. Dormant crowns for all the cultivars were obtained from Nourse Farms (South Deerfield, MA 01373). Crowns were planted on 11 April 2012 at 30.5 cm (12 in) spacing within the row. Following planting, Dacthal W-75 (DCPA) pre-emergent herbicide (AMVAC, Los Angeles, CA 90023) at 13.5 kg/ha (12 lb/A) was applied over the plant rows and middles with a boom sprayer. Straw mulch was spread between rows. Hand weeding and hoeing were

done through the summer. Blossoms were removed the first growing season. Plants runnered to form a 60 cm (24 in) wide matted row for fruiting. In the fall season, Devrinol 50-DF (Napropamide) pre-emergent herbicide (United Phosphorus Inc., King of Prussia, PA 19406) at 9 kg/ha (8 lb/A) was applied in mid-Nov. in a similar manner as the spring Dacthal application. Straw mulch was spread over the plant rows in early Dec. for winter protection. It was raked between the plant rows the following April. Drip and sprinkler irrigation were used to supplement rainfall during the growing season. Sprinkler irrigation was also used for spring frost control. Following the 2013 harvest, rows were renovated on 10 July for a second year of production. This involved mowing off the foliage above the plant crown and narrowing the plant rows to 30.5 cm (12 in) with a dual-head rotovator. This retained mother plants and some adjacent daughter plants. An application of Dacthal W-75 (DCPA) pre-emergent herbicide at 13.5 kg/ha (12 lb/A) and sprinkler irrigation followed two days later. Nitrogen was applied two weeks later at 45 kg per ha (40 lb per A). New runners were allowed to peg and root at random.

Plantings were harvested approximately two times per week over four weeks. Marketable and cull yields per plot were recorded in 2013 and 2014. Cull yield included fruit that were small, damaged by pests, or overripe. Small fruit were in the 5-6 g range or less. Total yield in kg per linear m row (Table 2) and percent marketable yield (Table 3) were reported. Percent marketable yield was based on the formula: [(total yield - cull fruit weight) / (total yield)] X 100. Fruit weight (g) was determined from a random 25-fruit sample taken at every picking. Weighted averages were calculated using the formula: summation of picking 1 through N [(fruit sample weight on day N / 25 fruit sample) X (yield on day N / total yield)] (Table 4). Dates for first, peak, last harvest, and season length (days) for each cultivar are reported (Table 5). A one-way analysis of variance was performed on the raw data by year using SPSS Statistics (IBM Corp., Armonk, NY 10504) and means separated by Tukey-Kramer HSD (P=0.05).

Results and Discussion

Strawberry bloom occurred from 24 April to 10 May in 2013. A low temperature of

Table 2. Total Yield of Strawberry Cultivars at Mountain Grove, MO 2013-2014.

	Total Yield (kg / linear m row)[z]		
Cultivar	2013	2014	2 Year Means
AC Wendy	3.3 ab[y]	2.5 bcd	2.9
AC Valley Sunset	3.4 ab	2.6 abcd	3.0
Allstar	3.9 ab	3.1 ab	3.5
Annapolis	3.3 ab	2.7 abc	3.0
Brunswick	3.6 ab	3.6 a	3.6
Daroyal	4.2 a	1.6 d	2.9
Donna	2.0 c	1.8 cd	1.9
Galletta	3.8 ab	2.7 abc	3.3
Jewel	3.0 bc	3.6 a	3.3
Record	3.9 ab	2.4 bcd	3.1
Yearly Means	3.4	2.7	3.1

[z] To convert to MT/ha, multiply by 5.55; to convert to T/A multiply by 2.45.
[y] Means in a column not followed by a common letter are significantly different by Tukey-Kramer HSD, $P \leq 0.05$.

0 ºC (32 ºF) was recorded on 2 and 3 May, but no blossom damage was noted. Yearly mean total yield of all cultivars was 3.4 kg per linear m row [8.3 tons per acre (T/A)] in 2013 (Table 2). This was comparable to previous cultivar trials in Missouri (Kaps and Byers, 2008; Kaps et al., 2003; Kaps et al., 1990). Matted-row strawberry cultivar trials in other states have shown comparable (Swartz et al., 1985; Stevens et al., 2007) or lower yields (Dozier et al., 1992; Handley and Dill, 2002). Yields were determined from 4 m (13 ft) research plots. Thus, it is risky to extrapolate from these small plots to larger plantings and assume that total yield will increase proportionally. A conservative estimate of what commercial strawberry growers might obtain is about one-half to two-thirds of cultivar trial yields because small and late fruit would not be harvested (Hancock et al., 1997).

In the second production year, blossoming occurred 22 April through 5 May 2014. There were no spring frosts during bloom. Yearly mean total yield of all cultivars was 2.7 kg per linear m row (6.6 T/A) row in 2014 (Table 2). This was a decrease from the first to the second production year of 21%. Previous trials have shown more of a decrease, ranging from 27 to 48% (Kaps and Byers, 2008; Kaps et al., 2003; Kaps et al., 1990). Missouri growers typically crop matted-row strawberries for several years. A progressive decline in yield will occur over several years due to competition between plant crowns, weed infestation, and foliar disease. Eventually matted-row strawberries become unprofitable after a number of bearing seasons and must be renewed (Hancock et al., 1997; Pritts, 2003; Pritts and Handley, 1998).

Most cultivars in the trial had yields suitable for commercial production in 2013. There were few significant differences across the cultivars (Table 2). 'Donna' had the lowest yield in 2014. A decline in yield occurred in 2014 for most cultivars but not all of them. 'Brunswick' and 'Jewel' either maintained or increased in yield in the second year. 'Brunswick' has shown consistency in yield and fruit size over four bearing seasons (Jamieson and Nickerson, 2004). 'Jewel' is a standard for the northeast US with good fruit size (Nourse, 2009; Pritts, 2003; Pritts and Handley, 1998; Weber, 2005). 'Daroyal and 'Donna' had the lowest yield in 2014. Reasonably consistent yielding cultivars were 'AC Wendy', 'AC Valley Sunset', 'Allstar', 'Annapolis', 'Galletta', and 'Record'.

'Allstar', 'Annapolis', and 'Brunswick' have yielded well in previous trials and performed well in the present trial (Kaps and Byers, 2008; Kaps et al., 2003; Kaps et al., 1990). 'Allstar' continues to be a popular offering by strawberry nurseries (Galletta et al., 1981; Hokanson and Finn, 2000; Nourse, 2009). 'Annapolis' is broadly adapted, productive, and early maturing (Estabrooks et al., 1989; Jamieson, 2003a; Jamieson, 2003b; Nourse, 2009). 'Brunswick' is a good high yielding, midseason cultivar that is an alternative to 'Honeoye' (Jamieson and Nickerson, 2004; Nourse, 2009).

Marketable yield percent averaged 74% in 2013 and 67% in 2014 (Table 3). These are lower than in previous trials when they exceeded 90% (Kaps and Byers, 2008; Kaps et al., 2003; Kaps et al., 1990). The highest marketable yields varied by year and cultivar with few significant differences across the cultivars. 'AC Wendy', 'Brunswick', 'Daroyal' had the highest marketable yield in 2013 and 'Jewel' highest in 2014 (Table 3). The previously stated consistent yielding cultivars had acceptable marketable yields, except for 'Record'.

Fruit weight is a weighted average of 25 fruit taken at each harvest. Thus, fruit weight is emphasized more on high yield dates. This is probably more representative of what a grower might obtain, since large and small fruit measured at lower yield dates have less emphasis. A fruit weight above 10 g was considered good in previous cultivar trials in Missouri (Kaps and Byers, 2008; Kaps et al., 2003; Kaps et al. 1990). The yearly mean fruit

Table 3. Marketable Yield of Strawberry Cultivars at Mountain Grove, MO 2013-2014.

	Marketable Yield (%)				
Cultivar	2013		2014		2 Year Means
AC Wendy	83.3	a[z]	73.3	ab	78.3
AC Valley Sunset	61.3	cd	66.3	ab	63.8
Allstar	75.8	abc	68.3	ab	72.1
Annapolis	77.3	abc	74.8	ab	76.1
Brunswick	84.5	a	62.0	b	73.3
Daroyal	82.0	a	70.5	ab	76.3
Donna	63.0	bcd	65.5	ab	64.3
Galletta	78.3	ab	69.3	ab	73.8
Jewel	75.3	abc	77.0	a	76.2
Record	55.0	d	45.3	c	50.2
Yearly Means	73.6		67.2		70.4

[z]Means in a column not followed by a common letter are significantly different by Tukey-Kramer HSD, $P \leq 0.05$.

weight for all cultivars was 11.9 and 11.0 g in the years 2013 and 2014, respectively (Table 4). 'AC Valley Sunset' had significantly larger fruit in both years along with 'Record' in 2014. 'Daroyal' had smaller fruit in 2013 and again in 2014 along with 'Donna'; however, they were not always significantly different from other cultivars. Yearly mean fruit weight dropped about 8% from 2013 to 2014 which is consistent with previous trials (Kaps and Byers, 2008; Kaps et al., 2003). Research has not shown a compensation in fruit size at lower yield in strawberry. Rather, fruit weight was negatively correlated to number of crowns per plant, plants per meter, and fruit set (Swartz et al., 1985). Plant and crown numbers would be expected to be higher in the second bearing year, although these were not determined in the trial.

Strawberry blossoming usually starts in mid to late April and extends into May in southern Missouri (Kaps et al., 2005; Kaps et al., 2003; Kaps et al., 1990). The blossoming period lasts about ten days depending on spring temperatures. The first harvest date is usually in late May. First harvest started on 24 May 2013 for the cultivars 'AC Wendy', 'Annapolis', and 'Daroyal' (Table 5). For

Table 4. Fruit Weight of Strawberry Cultivars at Mountain Grove, MO 2013-2014.

	Weighted Average (g)				
Cultivar	2013		2014		2 Year Means
AC Wendy	10.7	cd[z]	9.8	bc	10.3
AC Valley Sunset	17.5	a	13.9	a	15.7
Allstar	12.4	bc	11.0	b	11.7
Annapolis	10.7	cd	9.7	bc	10.2
Brunswick	11.4	c	11.2	b	11.3
Daroyal	8.2	d	8.9	c	8.6
Donna	10.1	cd	8.8	c	9.5
Galletta	11.2	c	9.8	bc	10.5
Jewel	12.6	bc	11.3	b	12.0
Record	14.2	b	15.1	a	14.7
Yearly Means	11.9		11.0		11.5

[z]Means in a column not followed by a common letter are significantly different by Tukey-Kramer HSD, $P \leq 0.05$.

Table 5. First, Peak and Last Harvest Dates of Strawberry Cultivars at Mountain Grove, MO 2013-2014.

	First Harvest		Peak Harvest		Last Harvest		Season Length (days)	
Cultivar	2013	2014	2013	2014	2013	2014	2013	2014
AC Wendy	24-May	22-May	29-May	27-May	20-Jun	9-Jun	28	19
AC Valley Sunset	6-Jun	30-May	13-Jun	2-Jun	24-Jun	13-Jun	19	15
Allstar	29-May	27-May	10-Jun	27-May	20-Jun	9-Jun	23	14
Annapolis	24-May	22-May	29-May	27-May	17-Jun	9-Jun	25	19
Brunswick	29-May	22-May	6-Jun	27-May	17-Jun	9-Jun	20	19
Daroyal	24-May	22-May	29-May	27-May	13-Jun	6-Jun	21	16
Donna	29-May	27-May	6-Jun	27-May	17-Jun	9-Jun	20	14
Galletta	29-May	22-May	31-May	27-May	17-Jun	9-Jun	20	19
Jewel	3-Jun	27-May	13-Jun	27-May	20-Jun	9-Jun	18	14
Record	10-Jun	30-May	13-Jun	6-Jun	24-Jun	13-Jun	15	15

these same cultivars, first harvest started on 22 May 2014 along with 'Brunswick' and 'Galletta'. The late cultivars 'AC Valley Sunset' and 'Record' had first harvest on 6 to 10 June 2013, and 30 May 2014. Peak harvest date occurred anywhere from the first picking date to twelve days later depending on cultivar. Season length averaged twenty-one days in 2013 and sixteen days in 2014. The latest harvest date occurred on 24 June 2013 and 13 June 2014 for 'AC Valley Sunset' and 'Record'. The short harvest seasons made it difficult to classify cultivars into early, mid, and late season categories for southern Missouri. There was considerable overlap in harvests for the cultivars.

Conclusion

Based on total and marketable yields, and fruit weight in 2013 and 2014, 'Daroyal' and 'Donna' are not recommended. 'Donna' had good total yield and berry size in both years, but marketable yield was lower and thus, it is not recommended. These cultivars are from French and Italian breeding programs (Table 1) and maybe less adapted to southern Missouri. Even so, other growers may find these cultivars to be productive and they should not necessarily be avoided. The remaining cultivars can be recommended to Missouri growers. 'Allstar' and 'Jewel' are already accepted by the strawberry industry as productive cultivars (Weber, 2005). The Maryland USDA cultivar 'Allstar' is well adapted to Missouri as it has performed well over many years and is a favored cultivar by growers (Kaps and Byers, 2008). The New York cultivar 'Jewel' has a long record of productivity and is also a favored cultivar by growers (Pritts, 2003; Pritts and Handley, 1998). The Canadian cultivars 'Annapolis' and 'Brunswick' did well in this trial and in previous trials and we continue to recommend them (Kaps and Byers, 2008; Kaps et al., 2003; Kaps et al., 1990). The two Canadian cultivars 'AC Wendy' and 'AC Valley Sunset' can be added to those recommended. 'Galletta' from North Carolina yielded well in both years and can also be recommended.

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About The Cover:

'Romang' is a new mid-season sweet persimmon cultivar from the National Institute of Horticultural and Herbal Science, Rural Development Administration in Korea.