

# **American Rose Trials for Sustainability® (A.R.T.S.®): A new United States rose trialing program for identifying and promoting regionally-adapted roses**

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## **Abstract**

There are numerous rose trialing programs worldwide that evaluate new roses in the marketplace and they differ in: number of sites and climatic conditions represented, level of scientific rigor employed, the evaluation criteria used, maintenance of roses, determination of awards, and the transparency with which the programs are organized and supported. The American Rose Trials for Sustainability® (A.R.T.S.®) program is a new rose trialing program initiated in 2012 in the United States by experts representing universities, rose nurseries, public gardens, and rose societies with the shared goal of identifying and promoting strong performing roses evaluated under low-input conditions. The A.R.T.S.® trials are managed by university scientists with years of experience in field research. The A.R.T.S.® leadership team consulted a wide range of stakeholders to ascertain which cultivar characteristics were most important and developed a new evaluation protocol in response. As with other ornamental plant evaluation programs, attractive floral attributes and flowering throughout the season are highly valued (42.5% of score). Also of great importance are foliar health and quality (45%) and growth habit (12.5%). The scientific credibility and transparency of A.R.T.S.® are strengthened in multiple ways including using: the Köppen climate classification system for region delineation, a randomized complete block experimental design, and a generated code for each genotype to shield identities of the cultivars and breeders from evaluators. Awards are determined on a regional basis with those cultivars earning awards in four or more regions designated as Master Roses. There are seven roses earning awards for 2018, the debut of the program to the public, with three roses (True Passion™, 'LIM10'; Icecap™, 'MEIradena'; and The Peachy Knock Out® Rose, 'RADgor') earning Master Rose designations.

## **INTRODUCTION**

The principal goal of award designating cultivar trials is to identify the cultivars that meet the criteria of the award. There are dozens of rose trials throughout the world, and the criteria and how the trials are managed differ (i.e. use of pesticides, nutrition management, spacing of plants, duration of trials, etc.; WFRS, 2018). Those trials that prioritize criteria important to consumers, and not easily detected while looking at roses in the retail setting, especially benefit consumers. For instance, criteria recognizing regional adaptability under low input conditions (e.g. regional disease, insect, and climatic tolerances) can help point consumers to those roses that given reasonable care, will have a high likelihood to succeed in their gardens and landscapes. In the U.S. the disease black spot, for instance, is the most problematic and widespread fungal disease and there are different races of the pathogen (Wolf) that vary from one region to the next (George et al, 2017). Trials that are multi-year, regional, and independently-conducted especially provide results consumers can trust and value (Zlesak et al, 2015).

## **THE NEED FOR A NEW UNITED STATES ROSE TRIAL**

A.R.T.S.<sup>®</sup> began in January 2012, and was prompted by the disbanding of the All-America Rose Selections<sup>®</sup> (AARS) program, an industry-managed US trialing program for new roses that began in 1938. AARS began, in part, due to the US Plant Patent Act of 1930 spurring an increase of rose introductions with nurseries having their own proprietary patented cultivars. It became difficult for consumers and industry members to determine which of the many new roses were superior. Previously, before the advent of plant patents, fewer new roses entered the marketplace and eventually those that proved to be of superior quality could be grown by anyone without a license. AARS started as an industry-led effort to coordinate trialing of unreleased cultivars. AARS trialed roses for a duration of 2 years at multiple locations across the nation. Member nurseries could enter new roses and obtain the data for internal decision-making. AARS board members would consider the data and vote on which roses would win awards, then AARS would help coordinate the propagation and marketing of winning roses. Member nurseries could benefit by becoming licensed to grow and sell winning roses, even if the rose was not one they submitted to the trial. Unfortunately, multiple member rose producers went out of business during the economic downturn that began in 2008 and that, in part, contributed to AARS's closure.

Very few rose trialing programs in the US have been undertaken and conducted on a regional basis with trialing locations across diverse geographic regions all evaluating the same cultivars during the particular trialing period. Even fewer have been conducted or are conducted by research and extension scientists having vast experience in independent plant trialing programs. In addition to A.R.T.S.<sup>®</sup>, to our knowledge, the Earth-Kind<sup>®</sup> Rose Trialing Program created by scientists with the Texas A&M AgriLife Extension Service is the only other rose trialing program in the US that meets these two criteria (Zlesak et al., 2015). Earth-Kind<sup>®</sup> trials differ from A.R.T.S.<sup>®</sup> in that the trial duration is longer and the roses trialed are typically established in the marketplace and are selected based on anecdotal evidence of strong regional performance.

The need for an independent trialing program with a national scope for new roses in the US is greater than ever due to the steady pace of new roses coming into the marketplace. Over the last decade, the horticulture industry has evolved and the trend is for fewer and larger nurseries to grow and distribute a wider range of plant species. Many large nurseries are also managing their own branded plant programs. Exclusive cultivars of roses and other species are sought to help create unique plant collections to distinguish themselves and draw customers to elite brands. New roses to supply the marketplace are not only coming from US breeders, but also from international rose breeders. The result is a steady supply of

new roses entering the US marketplace by a group of nurseries that may not necessarily have a long history with roses.

The characteristics consumers prioritize for roses in the US have been changing over the past two decades with people increasingly valuing roses that do well in the garden or the greater landscape under low-input conditions (Harp et al., 2009; Pemberton and Karlik, 2015). Roses with elevated levels of pest resistance are favored as consumers are now less willing to grow pesticide-dependent landscape plants and plants that take undue amounts of care to be aesthetically pleasing (Debener and Byrne, 2014; Waliczek et al., 2015). Having an unbiased, independent evaluation and awards program that trials new roses under low-input conditions across several US climates is a valuable contribution that A.R.T.S.<sup>®</sup> provides to the US horticultural community.

## **LEADERSHIP TEAM REPRESENTS A DIVERSITY OF STAKEHOLDER GROUPS**

From its inception, it was critical for A.R.T.S.<sup>®</sup> to have a leadership team not only representing industry, but also individuals with rose growing experience who can represent the needs of public gardens, rose society members, university scientists, landscapers, and, ultimately, the general gardening public. Having a strong mix of rose stakeholders represented within the A.R.T.S.<sup>®</sup> leadership team makes it possible to better identify the range of needs and available resources from each group, and strategically develop and sustain the most relevant rose evaluation and awards program possible.

The A.R.T.S.<sup>®</sup> leadership team includes university scientists with years of experience in rose research and conducting scientifically-sound field trials. Their expertise has led to the adoption of a number of practices to enhance the scientific validity of A.R.T.S.<sup>®</sup> trials relative to AARS and other rose trialing programs.

## **EXPERIMENTAL DESIGN AND CULTURAL MANAGEMENT**

A randomized complete block design is used in the A.R.T.S.<sup>®</sup> trialing program. Each trial site contains at least three blocks with one plant of each cultivar randomized within each block. Data are taken on a per plant basis. Blocking and randomization reduces confounding effects possible when all plants of a genotype are planted adjacent to each other, the typical protocol of most rose trials (WFRS, 2018).

One plant each of two control cultivars, currently The Knock Out<sup>®</sup> Rose ('RADrazz') and Carefree Beauty<sup>™</sup> ('BUCbi'), are included within each block of every trial. The use of control cultivars planted at each site and within each block aids in detecting differences in weather patterns and disease and pest pressure from year to year, and helps to ensure that award determinations are as unbiased, consistent and scientifically based as possible. These two cultivars were used as controls for three reasons: (1) they are popular and available throughout the country, (2) they typically survive in the climatic regions in which we are testing, and most importantly, (3) these two roses have gone through many years of evaluations in the long-term Earth-Kind<sup>®</sup> rose trials so there is ample performance data from throughout the US to give the A.R.T.S.<sup>®</sup> research team a reasonable expectation of good disease tolerance/resistance and overall performance. The control cultivars are the benchmark against which test roses are compared.

Plants are spaced a minimum of 1.2 m apart and allowed to grow without pruning to better determine their natural plant growth habit, with the exception of removing dead wood in spring.

It is difficult to find a rose, or any plant, that excels in all climates. Therefore, regional trialing and regionally-determined awards are crucial in helping people identify well-adapted rose cultivars for their landscapes and gardens. A.R.T.S.<sup>®</sup> uses the Köppen Climatic Classification System to distinguish regions, a system that is well-recognized by ecologists (Peel et al., 2007). The Köppen system determines regions by patterns of temperature and precipitation and there are nine primary Köppen climates in the continental US. They are: the semiarid steppe (Bsk), humid subtropical (Cfa), marine west coast (Cfb), Mediterranean (Csa), humid continental-warm summer (Dfa), humid continental-cool summer (Dfb), Highland-alpine (H), Tropical-wet/dry season (Aw), and the mid-latitude desert (Bwh) climates. The Köppen climates represented during different trialing periods can vary based on available trial sites.

The goal of the A.R.T.S.<sup>®</sup> program is to identify and promote rose cultivars that perform well in typical gardens within each US region. Individual trial sites are managed according to standardized cultural practices for the duration of the trial, which simulate what can be reasonably expected from a typical home gardener. The planting beds are prepared taking into account the results of a soil test and recommendations given by local Extension Services. For instance, when initially preparing the planting beds, if a soil test indicates that the area contains less than 5% organic matter, 7.6 cm of fully aged plant-based compost is added over the entire surface of the bed and tilled to a minimum depth of 15.2 cm.

Throughout the duration of the trial, a 7.6-cm layer of organic mulch (e.g., shredded wood chips and leaves with a particle size of ~2.5 to 5 cm) is maintained over the planting beds. No additional winter protection is provided. No synthetic or organic fertilizers are used during the course of the trial. Nutrition is provided by the initial organic matter and decomposing organic mulch. For the duration of the trial the roses are not dead headed (i.e., spent blossoms are not removed) or pruned except at the beginning of the second year when dead or winter-damaged canes are removed, or when one rose encroaches on an adjacent plant. Excessive water usage is also avoided. If the trial site experiences dry conditions, supplementary irrigation may be provided up to the equivalent of 2.5 cm of rainfall/week. Drip or soaker hose irrigation is preferred to reduce unnecessary disease pressure. No fungicides, insecticides or miticides are applied to the trial plants throughout the duration of the trial in order to effectively assess tolerance and resistance to regional diseases, insect, and mite pests.

## **DEVELOPING THE SCORING CRITERIA**

An early task for the A.R.T.S.<sup>®</sup> leadership team was to develop the criteria for rose evaluation. For award designations to be meaningful to consumers, the characteristics being evaluated must reflect what US gardeners and landscapers want and need, and should include important traits that are not easily determined by merely observing plants at the retail setting (e.g., disease resistance, mature growth habit, winter hardiness, etc.).

Waliczek et al. (2015) conducted a consumer preference survey of more than 1,800 respondents who identified that the most important traits in roses were disease resistance (54.7%), fragrance (28.7%) and flower color (16.5%). Similarly for the A.R.T.S.<sup>®</sup> program a wide range of rose stakeholder groups were consulted to learn which cultivar characteristics are consistently valued and the relative importance of these characteristics. Fortunately, there was strong consensus for what people valued which greatly streamlined the criteria development process and these preferences mimic those identified by Waliczek.

In the new scoring system, flowering throughout the season and attractive floral attributes are highly valued (42.5% of score), along with foliage health and quality (45%), and a pleasing, natural plant growth habit (12.5%) (Table 1). Data are taken on these attributes monthly throughout the growing season. Additional data are taken once per year including cane survival in spring. Data for each rose in comparison with the control cultivars are shared with breeders for their roses only at the end of each growing season.

## **TWO AWARD DESIGNATIONS**

At the end of the trial, the award determining criteria are straightforward and based on three key principles: (1) awards are determined regionally, (2) award winners for a region need to have >50% of the plants surviving until the end of the trial, and (3) the final mean score for the cultivar needs to be higher than the mean of the two control cultivars in the region. Year two data are given twice the weight of year one when calculating the final score. Greater weight is given to year two data because as plants mature regional climatic, disease, and insect pressures typically have an increasing impact on performance. For each region in which a trial rose demonstrates superior performance, it receives the A.R.T.S.<sup>®</sup> Local Artist award.

If a rose earns four or more Local Artist awards across the US, it is designated as an A.R.T.S.<sup>®</sup> Master Rose. The Master Rose award serves to honor those roses that have a wider range of adaptability. Because awards are based solely on performance with a well-defined threshold, there is no set number for how many or few roses can win each year. This approach helps all industry members with strong performing roses benefit from the program, and protects the credibility of the program by not having to designate winners each year when there may not be an entry that performs in a superior manner.

To better serve nurseries and the supply chain, once the A.R.T.S.<sup>®</sup> awards are determined and communicated to nurseries during the winter following the final data collection season, nurseries are given options for accepting the award. Awards can be accepted immediately for the following calendar year or awards can be delayed for another year or two as needed to help nurseries build stock to meet the demand for award-winning cultivars.

## **A.R.T.S.<sup>®</sup> PARTNERSHIPS**

A major strength of A.R.T.S.<sup>®</sup> is the partnerships that have been established to leverage resources to make the trials possible, especially since it is a volunteer-driven, non-profit organization. Key partners with the A.R.T.S.<sup>®</sup> leadership team include (1) nurseries providing rose entries and donating control cultivars, (2) trial sites donating space and labor to plant and care for the trial plants, and (3) volunteer evaluators who collect the data each month throughout the growing season.

Industry has been very supportive of the A.R.T.S.<sup>®</sup> program. In 2014, five different wholesale rose producers/breeding companies donated 22 cultivars for the A.R.T.S.<sup>®</sup> program to plant seven trial sites for validation of the evaluation criteria. The roses were established cultivars that have shown promise in the longer term Earth-Kind<sup>®</sup> rose trials. Data for these roses are presented in Table 2. Beginning in 2015, entries of trial roses began with three nurseries entering roses and paying entry fees to help offset costs to run the program. By 2017, the number of US nurseries providing entries grew to seven.

The A.R.T.S.<sup>®</sup> program has a close association with the Earth-Kind<sup>®</sup> rose trialing program (Harp et al., 2009; Zlesak et al., 2015). The Earth-Kind<sup>®</sup> trials share many of the same objectives as A.R.T.S.<sup>®</sup> (roses of both programs are evaluated under low-input conditions), with the key difference being that Earth-Kind<sup>®</sup> typically evaluates cultivars already established in the market and does so over a much longer duration. As roses pass

successfully through all the stages of the Earth-Kind® trials – typically a duration of 8 years, they are added to regional collections of Earth-Kind® recommended roses. Some of the evaluation criteria and cultural management practices for A.R.T.S.® were inspired by Earth-Kind® methodology, and there are some people on the leadership team belonging to both organizations. Roses that win A.R.T.S.® awards are natural candidates to be trialed in the longer-term regional Earth-Kind® trials.

Trial sites include botanical gardens, municipalities, universities and colleges that volunteer to host A.R.T.S.® trial sites. The benefits for trial sites that participate in the A.R.T.S.® program include the publicity the trials offer to draw visitors, and the prestige of being a key team member of the A.R.T.S.® program that contributes to the advancement of horticulture and knowledge of roses in their region. As of 2017, trials are capped at 20 cultivars and 60 plants to better accommodate trial sites with limited space. Trial sites in a region can partner with each other and alternate years planting the new set of cultivars. Other sites with more space can host two trials simultaneously – one group of trial roses in year one of assessment and the other group of trial roses in their second year. As of 2017, there have been thirteen different institutions that have hosted an A.R.T.S.® trial site (Table 3).

Communicating the message about the A.R.T.S.® program and the regional award winners to all US rose stakeholders is critical for the program to benefit the horticulture community. Besides the A.R.T.S.® website ([www.americanrosetrialsforsustainability.org](http://www.americanrosetrialsforsustainability.org)), it is essential to leverage media opportunities to spread the message. The A.R.T.S.® team is writing articles for trade magazines, popular press magazines, giving presentations on the program, and using social media to share links to articles about the program. Providing information about the program to the Garden Writers Association also helps disseminate information about the program efficiently to the public as horticultural media professionals share our story. Additionally, A.R.T.S.® has developed logos for the two award categories that nurseries can use in marketing materials for their winning roses. With a limited budget, it is important to use low-cost avenues to market the program and strategically equip horticultural media professionals and industry leaders to extend the reach of the program's message.

## **DEBUT OF THE FIRST A.R.T.S.® AWARDS**

The first award winning roses were announced for 2018 in the trade magazine *American Nurseryman* in May of 2017 and were trialed during the 2015 and 2016 growing seasons (Zlesak et al., 2017). Three of the seven award-winning roses earned Master Rose awards. The Master Rose award was given to Icecap™ ('MEIradena'), The Peachy Knock Out® Rose ('RADgor'), and True Passion™ ('LIM10', initially named Double 10™). In order to preserve the relationship with industry, it is the policy of A.R.T.S.® to only present data publicly on the winning roses for the regions in which they have won. These Master Rose awardees received Local Artist awards in all four regions that hosted the 2015-2016 A.R.T.S.® trial. While the DFA climate region only awarded these three roses as their Local Artist awards, other regions had additional roses to these three earning Local Artist awards. The CSA climate region additionally recognized Farruca™ Courtyard™ ('POULcy032') as a Local Artist. The CFA and DFB climate regions both recognized Look-A-Likes® Apple Dapple™ ('MEIplumty') as a Local Artist. Additionally, Look-A-Likes® BougainFeelya ('MEIckinava') and Petaluma Cover® Town and Country® ('POUItc004') also earned Local Artist awards in the DFB climate region (Table 4). Feedback from some of the industry professionals with award-winning roses has already been very positive during the summer of 2017 and A.R.T.S.® marketing spurred early wholesale orders for some of these cultivars.

## **CHALLENGES AND OPPORTUNITIES GOING FORWARD**

A.R.T.S.<sup>®</sup> is a non-profit organization that is operated by an unpaid volunteer board. Its officers, trial site managers, and evaluators are also volunteers. The organization relies on the generosity of its volunteers, the various municipal, university, and botanical gardens for space and supplies, as well as the donations of control cultivars from nurseries. However, there are business expenses (e.g., filing paperwork with the government as an official organization, website costs, etc.) and stable funding streams need to be developed to not only cover basic costs, but to strategically develop stronger marketing pipelines to showcase the overall program, winning roses, and the culture and use of roses generally. To date, resources to cover initial costs have come from cultivar entry fees and generous donations.

A.R.T.S.<sup>®</sup> intends to increase the number of trial sites so every major US Köppen climatic region is represented with two trial sites per region. As of September 2017, A.R.T.S.<sup>®</sup> has 8 trial sites confirmed to host trials in 2018 which represent four of the larger US climatic regions. The program has been strong in the North, South and Eastern portions of the nation and is looking to increase the number of trial sites in the Western regions. Having multiple trial sites per region is especially helpful to confirm the results of each site and adds to the credibility of the program as a whole, especially to consumers who will find value in identifying with and visiting a local trial site in their climatic region. A.R.T.S.<sup>®</sup> is also working to effectively communicate the Köppen climatic regions to the public by developing interactive maps on the website. Most consumers are unfamiliar with the Köppen climatic classification system, and since the regional boundaries do not match familiar state lines, communication of the Köppen regions will be an ongoing effort.

Another hurdle is modifications made to the US plant patent laws in 2013 that have changed what is deemed disclosure (Zlesak, 2014). This has made it more challenging for nurseries to enter advanced selections into independent trials due to the risk of not knowing or being able to fully control the disclosure date of their plants and, consequently, they may not be able to secure a US Plant Patent. Traditionally, disclosure was the first offer for sale of a cultivar. At that point, the clock started for a one-year grace period to file the US Plant Patent. After the one-year grace period passes, a plant cannot be patented. The updated law is more open-ended for what is deemed disclosure and can include something as simple as the plant being pictured and described in a distinguishing way on the internet. It is difficult for independent trials, like A.R.T.S.<sup>®</sup>, where trial sites are housed in public gardens or gardens which have days designated for public visitation to prevent people from taking and posting pictures on social media. In response, many nurseries are delaying entering advanced selections into independent trials until they have committed to introducing them as cultivars and have intellectual property rights secured or underway. To accommodate this challenge, A.R.T.S.<sup>®</sup> has responded by allowing nurseries to enter recently-introduced cultivars.

## **CONCLUSION**

A.R.T.S.<sup>®</sup> is excited to serve the niche of becoming the premier US rose awards program representing and linking multiple horticultural stakeholder groups promoting the use of regionally-adapted garden and landscape roses. With the scientifically-sound evaluation protocol and data results determining regional awards, the outcome is that consumers are highly likely to be successful with A.R.T.S.<sup>®</sup> award-winning roses for their region when plants are given basic care.

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## Literature Cited

- Debener, T., and Byrne, D.H. (2014). Disease resistance breeding in rose: current status and potential of biotechnological tools. *Plant Sci.* 228, 107–117 <https://doi.org/10.1016/j.plantsci.2014.04.005>. PubMed
- George, S., Harp, D., Peters, J., Zlesak, D., and Stein, L. (2017). True independence is the best approach in rose trialing. In *American Rose Annual*, G. Hammond, ed. (Shreveport, Louisiana: American Rose Society), p.44–48.
- Harp, D.A., Zlesak, D.C., Hammond, G., George, S.W., and Mackay, W.A. (2009). Earth-Kind® Rose Trials - identifying the world's strongest, most beautiful landscape roses. *Flor. and Ornam. Biol.* 3, 166–175.
- Peel, M.C., Finlayson, B.L., and McMahon, T.A. (2007). Updated world map of the Köppen-Geiger climate classification. *Hydrology and Earth System Sciences Discussions. European Geosciences Union* 4 (2), 439–473.
- Pemberton, H.B., and Karlik, J.F. (2015). A recent history of changing trends in USA garden rose plant sales, types, and production methods. *Acta Hort.* 1064, 223–234 <https://doi.org/10.17660/ActaHortic.2015.1064.25>.
- Waliczek, T., Byrne, D., and Holeman, D. (2015). Growers' and consumers' knowledge, attitudes and opinions regarding roses available for purchase. *Acta Hort.* 1064, 235–239 <https://doi.org/10.17660/ActaHortic.2015.1064.26>.
- World Federation of Rose Societies. (2018). <http://www.worldrose.org/trials/trialdates.asp>.
- Zlesak, D.C. (2014). Reflections and experiences regarding US plant patents. *Rose Hybridizers Assn. Newsl.* 45 (2), 9–15.
- Zlesak, D.C., Harp, D.A., Zuzek, K., Sloan, J.J., Owings, A., and George, S.W. (2015). Earth-Kind® Rose Trialing: an international model for the identification of regionally-adapted landscape roses. *Acta Hort.* 1064, 123–129 <https://doi.org/10.17660/ActaHortic.2015.1064.15>.
- Zlesak, D.C., Schwartz, M., Hammond, G., Nelson, R., Chamblee, M., and George, S.W. (2017). Rating roses. *Am. Nurse* 217 (5), 12–15.

Table 1. Maximum points allocated to each of the contributing traits in the A.R.T.S.® standard monthly evaluation rating.

Overall category	Character trait	Maximum point value
Flowers	Bloom coverage	2.00
	Bloom shape	0.50
	Fragrance	1.00
	Shedding of spent blooms	0.50
	Hip formation	0.25
Foliage	Foliage retention	1.50
	Lack of chlorosis	1.00
	Lack of disease	1.00
	Lack of insect and mite damage	1.00
Plant form	Growth habit	1.00
	Lack of dead canes	0.25
	Maximum point total	10.00

Table 2. Average overall A.R.T.S.<sup>®</sup> rating grouped by Köppen climatic region for 2014 planted roses scoring better than or equal to the mean of the controls Carefree Beauty<sup>™</sup> and The Knock Out<sup>®</sup> Rose.

Cultivar <sup>z</sup>	Köppen climate region			
	Dfa	Cfa	H	Bwk
Brite Eyes <sup>™</sup> ('RADbrite')	4.80 <sup>y</sup>	6.39	5.67	<sup>x</sup>
Carefree Beauty <sup>™</sup> ('BUCbi') (control)	3.92	5.49	5.45	6.11
Easy Does It <sup>™</sup> ('HARpageant')	4.64	5.57	6.08	6.17
Home Run <sup>®</sup> ('WEKcisbako')	5.22	7.02	- <sup>w</sup>	
Macys Pride <sup>™</sup> ('BAIcream')	4.85		5.78	6.70
Morden Blush	4.43	5.21		
My Girl <sup>™</sup> ('BAIgirl')	4.70	4.99	-	
Oso Easy <sup>®</sup> Peachy Cream ('HORcoherent')	4.36	5.62	-	
Oso Happy <sup>®</sup> Candy Oh! ('ZLEmartincipar')	5.38	6.34	-	
Oso Happy <sup>®</sup> Petit Pink ('ZLEMarianneYoshida')	5.19	6.55	5.66	5.85
Pink Home Run <sup>®</sup> ('WEKphorn')	4.87	6.78	5.82	
Sunrise Sunset <sup>™</sup> ('BAIset')	5.02	6.49	5.90	6.17
Super Hero <sup>™</sup> ('BAIsuhe')	4.66	5.67	5.71	5.93
Sweet Fragrance <sup>™</sup> ('BAInce')		5.42		6.73
The Blushing Knock Out <sup>®</sup> Rose ('RADyod')	5.24	6.52	5.76	6.19
The Coral Knock Out <sup>®</sup> Rose ('RADral')	4.77	5.41	-	5.97
The Double Knock Out <sup>®</sup> Rose ('RADtko')	5.16	6.51	5.85	6.54
The Fairy	5.30	6.42	-	
The Knock Out <sup>®</sup> Rose ('RADrazz') (control)	4.69	4.42	5.64	5.54
The Pink Double Knock Out <sup>®</sup> Rose ('RADtkopink')	4.59	5.04	5.68	6.46
The Pink Knock Out <sup>®</sup> Rose ('RADcon')	5.28	6.48	5.84	6.15
Yellow Submarine <sup>™</sup> ('BALine')		6.41	-	6.45

<sup>z</sup> Cultivar name or trademark name followed by cultivar name in parentheses.

<sup>y</sup> Data presented was collected year two or years two and three of this trial at each site within region and not the first year of planting since the data collection protocol presented in Table 1 was not yet finalized.

<sup>x</sup> Roses without a value by them scored less than the mean of the controls. In order not to overly draw negative attention to these cultivars, the policy of the A.R.T.S.<sup>®</sup> program is to not report the specific data in such instances.

<sup>w</sup> Roses with a dash by them were not included in Köppen climatic H due to space limitations at Salt Lake City, Utah trial site.

Table 3. Sites having hosted A.R.T.S.<sup>®</sup> trials as of 2017 and their Köppen climatic region.

Köppen climatic region	Trial site host	Location
Dfb	Boerner Botanical Gardens	Hales Corners, Wisconsin
Cfa	City of Farmers Branch	Farmers Branch, Texas
Cda	City of Tyler	Tyler, Texas
Csa	Descanso Gardens	La Cañada Flintridge, California
Dfb	Green Bay Botanical Garden	Green Bay, Wisconsin
Dfa	Longwood Gardens	Kennett Square, Pennsylvania
CFa	Louisiana State University	Hammond, Louisiana
Bwh	Mesa Community College	Mesa, Arizona
Csa	Morcom Rose Garden	Oakland, California
Dfa	Naugatuck Valley Community College	Waterbury, Connecticut
Dfb	North Dakota State University	Absaraka, North Dakota
Dfa	Swarthmore College	Swarthmore, Pennsylvania
Cfa	Tulsa Parks and Recreation	Tulsa, Oklahoma
Dfb	University of Minnesota Extension - Clay County	Dilworth, Minnesota
H	University of Utah	Salt Lake City, Utah

Table 4. Average overall A.R.T.S.<sup>®</sup> score grouped by Köppen climatic region for 2015 planted roses scoring better than or equal to the regional mean of the control cultivars Carefree Beauty<sup>™</sup> and The Knock Out<sup>®</sup> Rose.

Cultivar <sup>z</sup>	Köppen Climatic Classification			
	Bwh	Cfa	Dfa	Dfb
Carefree Beauty <sup>™</sup> ('BUCbi')	4.76 <sup>y</sup>	5.63	4.55	5.51
Farruca <sup>™</sup> Courtyard <sup>®</sup> ('POUlc032')	5.04	- <sup>x</sup>	w	-
Icecap <sup>™</sup> ('MEIradena')	4.90	6.39	5.49	6.84
Look-A-Likes <sup>®</sup> Apple Dapple ('MEIplumty')	-	6.30		6.54
Look-A-Likes <sup>®</sup> BougainFeelYa ('MEIckinava')				6.71
Petaluma <sup>™</sup> Cover Town and Country <sup>®</sup> ('POUItc004')				6.02
The Knock Out <sup>®</sup> Rose ('RADrazz')	4.82	6.37	5.74	6.43
The Peachy Knock Out <sup>®</sup> Rose ('RADgor')	5.23	6.34	5.38	6.06
True Passion <sup>™</sup> ('LIM10')	5.11	7.01	5.55	6.21

<sup>z</sup> Cultivar name or trademark name followed by cultivar name in parentheses.

<sup>y</sup> Year two scores are weighted twice as heavy as year one scores in the presented means.

<sup>x</sup> Data of roses with a dash by them at a particular region do not have data presented because plant quality when received was questionable and plants did not establish well.

<sup>w</sup> Roses without a value by them scored less than the mean of the controls. The policy of the A.R.T.S.<sup>®</sup> program is to not report specific data in such instances.