

Combating Horticultural Misinformation through Integrated Online Campaigns Using Social Media, Graphics Interchange Format, and Blogs

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SUMMARY. Misinformation relating to horticulture can spread quickly among laypersons. Although some misinformation may be harmless, such as the myth that bell pepper (*Capsicum annuum*) fruit can be either male or female, other misinformation is generated to sway consumer decisions. The demand from Cooperative Extension Service (CES) agents for support to combat the spread of horticultural misinformation, horticulture specialists at the University of Arkansas System Division of Agriculture Cooperative Extension Service (UACES) created a “Horticulture Fact or Fiction” series of blog posts that targeted common horticulture myths with science-based explanations and used graphics interchange format (GIFs) to promote the blog posts on social media. The integrated social media campaign was shared on the authors’ UACES Horticulture social media accounts and by eight UACES agents during 2021. The effort reached 13,397 social media users, and the blog posts had a total of 45,544 pageviews. Although social media was not the major driver of traffic to the blog post series, GIF-based outreach on social media did direct more than 1000 additional users to the blog posts. Through this integrated approach of using social media and GIFs shared by both specialists and CES agents, we were able to connect a large number of stakeholders to research-based content, resulting in higher average traffic to our webpage-based blogs than the average UACES webpage. This type of integrated approach using multiple online means of communication including GIFs, blogs, and social media to create a toolkit of resources for CES agents may be useful for extension professionals targeting stakeholders online.

Horticultural misinformation can spread quickly among laypersons (Chalker-Scott and Downer, 2018). In this context, “misinformation” is used to mean anything that is false or not true. Wu et al. (2016) found that although social media services enable people to share and seek information effectively, they are also one of the most effective channels for misinformation. Horticulture has not been spared from these distortions. Some misinformation in

horticulture, such as the myth that bell pepper (*Capsicum annuum*) fruit can be male or female, has become so widespread as to reach mainstream news (Lomeli, 2021). Solis-Toapanta et al. (2020) found that horticulture misinformation, particularly related to gardening, can be disseminated on social media platforms. This can range from harmless myths to claims that target a consumer’s actions and may be intentionally misleading, often called disinformation, including the annual publication of the Environmental Working Group’s (Washington, DC) “Dirty Dozen” list of produce items (McWhirt et al., 2021; Winter and Katz, 2011).

As technology advances and client bases change, many CES professionals have turned to Internet-based forms of information dissemination such as social media (Gharis et al., 2014). Stafne (2020) found that the social media platform Twitter (Twitter, Inc., San Francisco, CA) specifically offers a new and effective way to

communicate with stakeholders, with the added benefit of quantitative data tracking. Other social media platforms like Facebook (Meta Platforms, Menlo Park, CA) and Instagram (Meta Platforms) offer similar reach and metric tracking that can be used to monitor the number of people contacted by the information shared. In addition to social media, blogs can be an effective way to share research-based information from CES professionals (Davis and Stollar, 2019; Gillman et al., 2011). Because blogs typically have no character limits or other restrictions, CES professionals can use blogs to create free and accessible research-based content for stakeholders that is easily shared across other Internet-based platforms such as social media, newsletters, or e-mail.

Characteristics of the content posted on social media have important impacts on the level of engagement and attention a post may generate. Certain best management practices for online communication, such as including photos in Twitter posts, has been shown to increase engagement, with “eye-catching” material being the key to engaging users (Doyle and Briggeman, 2014; Stafne, 2020). GIF images are moving pictures with no audio that may have similar impact as still images when used in a social media post, but this has not been widely tested in CES outreach.

When the COVID-19 pandemic began, there was an increase in people starting to garden and seek out horticultural knowledge online; further, 35% of gardeners have reported finding most of their gardening information online (Bulgari et al., 2021; Weisenhorn et al., 2021). During 2020, when many outreach efforts by CES agents moved to virtual formats, agents increasingly encountered, and were called on to confront, horticulture misconceptions shared online. In Arkansas, CES agents requested scientifically based resources from the UACES horticulture specialists to counter commonly shared falsehoods related to horticulture.

Due to the demand from CES agents for support to combat the spread of misinformation related to horticulture, the UACES Horticulture Program created a “Horticulture Fact or Fiction” blog post series and a

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social media campaign that used GIFs to drive website traffic to the blogs. The goal of this campaign was to provide CES agents with tools to connect misled stakeholders to research-based information. The impacts of this integrated approach to online outreach were analyzed to determine the effectiveness of creating a toolkit for CES professionals using social media, GIFs, and blog posts to drive stakeholders to research-based information on common horticultural misconceptions.

Materials and methods

In Jan. 2021, five common horticulture misconceptions that are widely circulated online were identified by UACES Horticulture Specialists with input from CES agents. The five misconceptions targeted were as follows: 1) “female” bell peppers have four to five lobes and are sweeter than “male”

bell peppers that have only three lobes, 2) squash (*Cucurbita pepo*) can cross-pollinate with cucumber (*Cucumis sativus*), 3) the list of the “Dirty Dozen” fruits and vegetables are unsafe to eat because they have the highest pesticide residues; 4) adding sand to clay soils will improve drainage, and 5) large fruit size on strawberries (*Fragaria × ananassa*) indicates that they are genetically modified organisms (GMOs). For each misconception, a blog post was written and posted to the authors’ established blog (McWhirt, 2021a, 2021b, 2021c, 2021d, 2021e). Each post followed the same format and included the following: 1) a description of the misconception, 2) a “quick take” meant to quickly explain why the misconception is false, and 3) follow-up with a longer explanation of the science or research on the topic. For each blog post, a corresponding GIF

was created using the graphic design platform Canva (Canva, Inc., Sydney, Australia). Each GIF (Fig. 1) was designed using a similar template that featured the misconception in question form at the top, followed by the relevant GIF, such as a “clean” shining pear (*Pyrus communis*) and a “dirty” strawberry in mud to reflect the “Dirty Dozen” list. Below each moving picture was additional text to add context to the misconception, but ultimately the question remained unanswered to encourage viewers to click through to the blog. At the very bottom of each GIF was the “Horticulture Fact or Fiction” graphic and the University of Arkansas System Division of Agriculture logo. Text-based captions were developed to accompany each GIF when posted on social media that restated the common misconceptions with the question remaining unanswered. This text



Fig. 1. Five “Horticulture Fact or Fiction” GIFs made for social media addressing five common horticultural misconceptions: 1) “female” bell peppers (*Capsicum annuum*) have four to five lobes and are sweeter than “male” bell peppers that have only three lobes, 2) squash (*Cucurbita pepo*) can cross-pollinate with cucumber (*Cucumis sativus*), 3) the list of the “Dirty Dozen” fruits and vegetables are unsafe to eat because they have the highest pesticide residues, 4) adding sand to clay soils will improve drainage, and 5) large fruit size on strawberries (*Fragaria × ananassa*) indicates that they are genetically modified organisms (GMOs).

was followed by a bitly link (Bitly Inc., New York, NY) connecting to the relevant blog post, encouraging readers to “learn more” (Fig. 2). Each caption also included the hashtag #UAEXHort. This hashtag allowed posts from Twitter to show up on a sidebar on the UACES commercial horticulture website, which means that people browsing the website may have also seen these posts.

The captions and GIFs were posted on the UACES Horticulture social media platforms (Facebook: @UAEXfruitandveggie; Twitter: @fruitveg_ualex) and shared with all UACES agents in Arkansas via a shared folder on Box (Box, Inc., Redwood City, CA) for their own use starting 20 Jan. 2021. To determine the reach and impact of this campaign, the CES agents who accessed

the Box folder were identified and it was verified on their social media pages that the GIF and captions were shared. As of Nov. 2021, eight UACES agents had posted some version of the images and captions provided, which accounts for around half of the agents notified of the campaign toolkit through a monthly webinar. Using Twitter Analytics and Facebook Insights, six of these UACES agents provided the total number of engagements and people reached per post. The analytics retrieved from UACES agents were added to the analytics of the author’s posts to sum the total people reached and total interactions. For example, “people reached” is a reflection of how many Twitter or Facebook users saw the post come across their screens and “interactions” are defined as the total number of likes, retweets, shares, and comments a post received.

Google Analytics (Google LLC, Mountain View, CA) “page views” were collected for each of the five “Horticulture Fact or Fiction” blog posts. Page views are the number of instances an Internet user visited each blog post. In addition, how users were directed to the blog webpages were collected and included either by social media (Facebook or Twitter), search engines [such as Google (Google LLC) or Bing (Microsoft Corp., Redmond, WA)], or direct clicks [a user was already on the UACES website (University of Arkansas System Division of Agriculture, 2022) and found the blog post directly]. The percent of total blog page views coming from each source was calculated.

The posts were also shared on the authors Instagram page (@uark_fruitandveggie), but due to limited access to analytics, these data were omitted from this analysis. Analysis of the people reached and number of interactions on social media was performed in statistical software (JMP ver. 16.1; SAS Institute Inc., Cary, NC) with the fit model procedure and means separated by Student’s *t* test at $P < 0.05$.

Results and discussion

Through this integrated “Horticulture Fact or Fiction” social media and blog campaign, slightly more people were reached on Twitter (8061) than Facebook (7316), and as



Fig. 2. Example of “Horticulture Fact or Fiction” Twitter post on the author’s Twitter account containing caption with a bitly link that links to a blog post with more information on the horticultural misconception regarding whether squash (*Cucurbita pepo*) can cross-pollinate with cucumber (*Cucumis sativus*), and the GIF created.

a result, more people interacted with the posts on Twitter than on Facebook, despite that the posts were shared on Facebook almost 2 times more than on Twitter (Table 1). The higher number of interactions on Twitter are likely related to Twitter analytics considering “media views” (the number of times users click an image) and the number of link clicks as an interaction or engagement, whereas Facebook only counts shares, reactions, and comments as interactions. Each of the prewritten social media posts and accompanying GIFs were posted a different number of times by multiple accounts, with the “sand to clay soils” post being posted more ($n = 12$; of those $n = 4$ on Twitter, $n = 8$ on Facebook) than other blog posts. However, despite differences in the number of times posts were shared, all the topics reached similar numbers of people and had similar numbers of interactions on social media.

In total, the “Horticulture Fact or Fiction” social media posts reached 13,397 users on Twitter and Facebook and garnered a total of 579 interactions across the two platforms (Table 1). However, a fraction of these users subsequently clicked through to the blog post (77 Twitter users and 1063 Facebook users)

(Table 2) and instead the majority of the 45,544 visitors reached by the “Horticulture Fact or Fiction” blog posts came from search engines. Generally, search engines accounted for the majority (64%) of traffic to the blog posts. The high percentage of total page views resulting from search engines for the blogs demonstrates that stakeholders were actively seeking more information on the selected horticultural topics. The majority of blog post visits were attributed to the post concerning male and female bell peppers, which had a total of 40,840 visitors, or 97% of all visits. The topics with the second- and third-highest number of blog post page views were posts discussing the Environmental Working Group’s “Dirty Dozen” list (1167 views) and “GMO strawberries” (916 views). The blog post with the lowest number of page views was the squash cross-pollination post with 131 visitors as of Nov. 2021. The phrasing of this blog post could have been too specific; some stakeholders searching for this information may have been interested in whether other types of cucurbits (Cucurbitaceae) can cross-pollinate, whereas our blog post title specifically addressed squash.

Some additional traffic did come from social media platforms, where on

average 0.9% of blog post visits came from Twitter and 15% came from Facebook (Table 2). The higher number of people reaching the blog from Facebook could be due to the difference in audiences between the two platforms. For the @fruitveg_uacx Twitter account, the majority of followers are academics or CES agents who “retweet” or “like” informative posts but may not click the links because they are familiar with the content. In contrast, the authors’ Facebook followers are typically stakeholders or growers who are more likely to be seeking out new information. This is consistent with the findings in Barton et al. (2017) where green industry consumers were more likely to be found on Facebook and professional conversations were more common on Twitter. In the future, the authors will use this information to better target program development efforts for CES clients on Facebook.

Although generally a low percentage of blog post visits came from social media, for the “cross pollination” and “sand added to clay” posts, more than 20% of the blog post visits originated from Facebook (Table 2). The “sand added to clay” post was shared the most times on social media, and the “cross pollination” post had the similar number of visitors from search engines as from Facebook. The number of times a post is shared and the number of followers an account has are important metrics for determining potential number of users reached. Of the three CES agent Facebook accounts with the highest number of followers ($n = 9282$, 1752, and 1401), the “cross pollination” and “sand added to clay” were the only posts shared on all three accounts and were also the posts that had the highest proportion of blog post views from social media (data not shown). For instance, the “sand to clay soils” post, which had the most social media shares, also had a larger proportion of its blog post page views come from Facebook (26%) and Twitter (3.2%), which is higher than social media directs for other posts, which averaged 15% for Facebook and 0.9% for Twitter.

This demonstrates that social media can be an important component of an integrated outreach campaign intended to drive traffic to a blog post

Table 1. Number of times five topics of “Horticulture Fact or Fiction” in GIFs were posted on the social media platforms Facebook and Twitter and the resulting total reach and total interactions. The five horticultural misconceptions included: 1) “female” bell peppers (*Capsicum annuum*) have four to five lobes and are sweeter than “male” bell peppers that have only three lobes, 2) squash (*Cucurbita pepo*) can cross-pollinate with cucumber (*Cucumis sativus*), 3) the list of the “Dirty Dozen” fruits and vegetables that are unsafe to eat because they have the highest pesticide residues, 4) adding sand to clay soils will improve drainage, and 5) large fruit size on strawberries (*Fragaria xananassa*) indicates that they are genetically modified organisms.

Effect	Times posted ^z (no.)	People reached ^y (no.)	Interactions ^x (no.)
Platform			
Twitter	14 b	8061 a	424 a
Facebook	25 a	7316 b	124 b
P value	<0.001	<0.001	<0.001
Topic			
Bell pepper	7 b	2517	126
Cross pollination	8 b	1884	90
“Dirty Dozen”	9 b	2838	157
Sand to clay soils	12 a	3835	143
GMO strawberries	9 b	2323	63
P value	0.02	0.60	0.90
Platform × topic		0.74	0.57

^zTotals followed by the same letter are not different by Student’s *t* test at $P < 0.05$.

^yNumber of users on Twitter or Facebook who saw the post come across their screens.

^xTotal number of likes, retweets, shares, and comments a post received.

Table 2. Sources of pageview traffic from Twitter, Facebook, or search engines to “Horticulture Fact or Fiction” blog posts covering five topics of common horticultural misconception as of 11 Nov. 2021. The five horticultural misconceptions included: 1) “female” bell peppers (*Capsicum annuum*) have four to five lobes and are sweeter than “male” bell peppers that have only three lobes, 2) squash (*Cucurbita pepo*) can cross-pollinate with cucumber (*Cucumis sativus*), 3) the list of the “Dirty Dozen” fruits and vegetables that are unsafe to eat because they have the highest pesticide residues, 4) adding sand to clay soils will improve drainage, and 5) large fruit size of strawberries (*Fragaria ×ananassa*) indicates that they are genetically modified organisms.

Topic	Pageviews (no.)	Twitter ^z		Facebook		Search engines	
		Directs (no.)	Pageviews (%)	Directs (no.)	Pageviews (%)	Directs (no.)	Pageviews (%)
Bell pepper	42,872	47	0.01	751	2.0	40,840	95.2
“Dirty Dozen”	1,167	15	1.0	88	9.0	893	76.5
GMO strawberries	916	0	0.0	73	8.0	762	83.1
Sand to clay soils	427	15	4.0	112	26.0	169	39.5
Cross pollination	131	0	0.0	39	30.0	39	29.7
Total	45,544	77	0.2	77	0.2	42,703	93.8

^zNot included in this table is traffic that was directed via direct clicks from the University of Arkansas, System Division of Agriculture Cooperative Extension Service webpage, which ranged from 3.9% to 29.7% for the five blog posts.

or a website, but that social media is most effective when posts are shared by accounts with large numbers of followers or subscribers. This online outreach campaign was unique in that we used extension specialist expertise to provide extension agents with a toolkit they could use to share research-based information with their existing social media networks. Limited county agent participation ($n = 8$) likely limited the impact of the project during the period for which we collected data. However, the campaign tools are still available to agents and occasionally are newly shared, resulting in longer term impacts for which we may collect further information on at a later date.

Our social media campaigns involving GIFs resulted in 15.9% of the traffic to the blog posts. It is not possible to comment on the success of GIFs compared with still images in driving traffic to blogs from this analysis. There were some instances of CES agents sharing the GIFs as still images because of how they downloaded the file; however, this occurred infrequently, and despite differences in the number of followers across CES agents’ social media accounts, no noticeable changes in engagement occurred for posts using the still image. The attractiveness or visual engagement of the GIFs used in this effort likely had some impact on our results; however, testing varying visual engagement levels of GIFs is outside the scope of this work. Further, it is difficult to compare the reach of this campaign to other posts on the authors’ blog for which no campaign was conducted because the majority of our other blog post are targeted to grower

audiences, not the layperson, as was the target audience in this work.

The high number of search engine directs to the blog for the “bell pepper” post may be due to the phrasing of the title as a question, which may have closely matched what Internet users searched, resulting in an increase in search engine optimization. Search engines consider titles, along with keywords, to be very important in search optimization (Palmer, 2006). For this reason, each blog post was titled in the format of a common question that a user may search on Google or a similar search engine, and our exact phrasing may not have matched most common search terms for the other posts.

Although not reported in Table 2, the number of blog page views for the “Horticulture Fact or Fiction” blog posts were also categorized by the device type visitors used to access the posts, such as a desktop computer, smartphone, or tablet. Mobile visits represented the majority (89%) of traffic for the five blog posts on average. This is consistent with Jones et al.’s (2014) findings that extension blog pageviews have been transitioning from majority desktop visitors to majority mobile visitors. The UACES website managers require pages to be mobile-friendly, which may also have contributed to our high number of mobile visitors and ultimately the total reach of the blog posts.

Although social media that uses GIFs was not determined to be the source of most traffic to the “Horticulture Fact of Fiction” blog posts, social media outreach efforts drove more than 1000 additional visitors to the blog posts as a part of our outreach campaign. We found that the

use of GIFs on social media could be a successful component of an online social media campaign to connect stakeholders to research-based content housed on blog posts, although we were unable to determine whether GIFs were more effective than still images. Overall, the “Horticulture Fact or Fiction” media campaign had significant impacts on connecting stakeholders to science-based information to counter horticultural misinformation, as the “bell pepper” blog post alone was among the top-performing webpages in terms of reach on the entire UACES website in 2021 (A. Cole, personal communication).

Ultimately our work showed that an integrated outreach campaign that uses multiple online communication channels can maximize reach to stakeholders by targeting different types of Internet users.

Extension professionals interested in developing an outreach campaign to serve local needs should make use of online communication best practices as we have outlined, such as taking advantage of search engine optimization, knowing the interests of your social media audience, getting posts shared on social media accounts with high visibility, using visual engagement like a photo or moving image, ensuring webpages are optimized across devices, and selection of pertinent topics.

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