The Vegetable Variety Navigator Decision-support Tool: An Interactive Visualization of Variety Trial Meta-analysis Results

Ali Loker¹ and Sam E. Wortman²

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SUMMARY. Variety trials provide growers with critical insight about how a specific variety might perform on their farm. Unfortunately, local variety trial data are often limited for specialty crop growers, especially those located outside of major production regions. One possible solution to this problem is to aggregate and synthesize existing variety trial results from many regions to help inform crop variety choices in regions without these data. We performed a systematic literature review and meta-analysis of all publicly available variety trial data for broccoli (*Brassica oleracea*), cucumber (*Cucumis sativus*), and sweet pepper (*Capsicum annuum*) to identify broadly adapted, high-yielding, and high-quality varieties of each crop. We extracted data from 288 sources and calculated mean relative yield and/or quality estimates for 85 broccoli, 104 cucumber, and 144 pepper varieties that were evaluated across a minimum of three distinct locations. Results of this meta-analysis were used to develop the Vegetable Variety Navigator—an online decision-support tool that allows users to search and compare the mean and potential range of yield and quality performance for specific varieties. Users can also explore an interactive map to discover how variety performance is influenced by region, climate, and soil texture. The Vegetable Variety Navigator distills an otherwise overwhelming amount of variety trial data into a user-friendly web tool for growers that is intended to complement, not replace, existing sources of information about local variety performance.

Crop variety trials provide growers with valuable performance data to help inform variety choices for their farms (Pellack and Karlen, 2017; Williams and Roberts, 2002). Variety trials can also inform breeding efforts (Pellack and Karlen, 2017), which can accelerate progress toward food stability, climate change

resilience, resource efficiency, and other complex agricultural challenges. The objective of variety trials is to evaluate varieties in specific environments where each environment encompasses a combination of the variability introduced by the location and season (Acquaah, 2009), which is often defined as site-years. Regional collaborations can offer results from multiple years and diverse locations, thereby greatly expanding the inference space and applicability of variety trial results (Rangarajan, 2002). The current approach to variety trials includes the use of check varieties, replicated experimental design, and common production practices, as well as data collection and statistical analysis (Williams and Roberts, 2002). Yield is typically the most important and common trait evaluated during variety trials, although food quality and consumer preference are also important evaluation criteria, especially for fruit and vegetable crops (Brown et al., 2020).

The majority of vegetable variety trials are conducted at a single location. As recent examples, O'Connell

(2021) evaluated eight varieties of lettuce (*Lactuca sativa*) in field and high-tunnel systems at one location in Georgia. Afton et al. (2020) evaluated 45 varieties of lettuce at one location in Louisiana. Boyhan et al. (2020) compared 13 pepper (*Capsicum annuum*) varieties at one location in Georgia. Warren et al. (2015) studied 15 tomato (*Solanum lycopersicum*) varieties at one location in New Hampshire. Single-location variety trials are common for a good reason: conducting variety trials is expensive and time-intensive, and it is not possible to evaluate all varieties of interest with a single trial or in all desired environments (Brown et al., 2020). However, the inference space of results from a single-location variety trial is realistically limited to that single farm or others very similar to it in terms of climate, soil, and management. Although university-sponsored trials are often considered impartial, reliable sources of variety and location-specific performance data (Maynard, 2002; Pellack and Karlen, 2017; Williams and Roberts, 2002), fewer trials are conducted today because of reduced public research funding, fewer extension personnel, and fewer public vegetable breeders (Williams and Roberts, 2002). In addition, Brown et al. (2020) noted that some researchers may be reluctant to share raw data for fear of misrepresentation or because of resource constraints (Brown et al., 2020). There is also a lack of standardization for variety trial reporting (Brown et al., 2020; Rangarajan, 2002; Williams and Roberts, 2002) that limits comparisons among studies. The reduced availability and standardization of trial data contribute to widespread limitations in the long-term integration of data, as identified by Rangarajan (2002).

Results of individual variety trials can be extrapolated by aggregating data and using statistical models to predict and explain variety performance in other environments using environmental and genotypic covariates (Brown et al., 2020). van Etten et al. (2019) evaluated common bean (*Phaseolus vulgaris*), durum wheat (*Triticum durum*), and bread wheat (*Triticum aestivum*) in Nicaragua, Ethiopia, and India, respectively, using crowdsourced data. During this study, farmers categorically ranked varieties on their farm and researchers developed useful climatic models to extrapolate results

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¹Doctor of Plant Health Program, University of Nebraska-Lincoln, 279 Plant Sciences Hall, Lincoln, NE 68583

²Department of Agronomy and Horticulture, University of Nebraska-Lincoln, 279 Plant Sciences Hall, Lincoln, NE 68583

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S.E.W. is the corresponding author. E-mail: swortman@unl.edu.

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and variety recommendations across locations (van Etten et al., 2019). Lyon et al. (2020) used an analysis of variance to assess the adaptability of squash (*Cucurbita moschata*), broccoli (*Brassica oleracea*), and carrot (*Daucus carota*) varieties across dozens of on-farm locations in several states within their breeding network for organic vegetables. The adaptability analysis was used to identify broadly adapted varieties (those that perform well in most environments) and specifically adapted varieties (those that perform well specifically in high-yielding or low-yielding environments). They found the adaptability analysis to be useful for quantitative variables, like yield, but less valuable for qualitative variables, like flavor (Lyon et al., 2020). Munaro et al. (2020) aggregated data from 748 regional wheat (*Triticum*) variety performance trials across 92 locations and 19 years and used variance partitioning to identify the relative influences of regional climate, management, and genetics on variety traits. Climate and management explained the majority of variation in yield, whereas genetics explained only 2% of the variation (Munaro et al., 2020). Laurent et al. (2015) used a meta-analysis and mixed-effect models to compare potential yields of different energy crop species using direct (within study) and indirect (among study) comparisons to develop a relative ranking of the most promising crops. A similar meta-analysis approach may be useful for comparing the yield and quality of vegetable varieties within and among studies and regions. Overall, there have been far fewer efforts, particularly for specialty crops compared with field crops, to aggregate variety trial data across studies, networks, regions, and countries. Moreover, specialty crop variety trial data that are publicly available are disaggregated across countless sources and not synthesized in a way that can aid grower decision-making.

To address this gap, we aimed to aggregate and synthesize vegetable variety trial data from around the world, explore descriptive and explanatory trends, and present a synthesis of trial results in a user-friendly online decision-support tool. Our specific objectives were to conduct a systematic literature review and extract yield and quality data from publicly available broccoli, cucumber (*Cucumis sativus*), and sweet pepper variety

trials; to analyze these data and make indirect, relative comparisons between varieties from different studies, environments, and seasons; to identify potential explanatory relationships between local conditions and yield; and to visualize these data in a free online tool for growers, extension personnel, researchers, breeders, and other interested parties.

Materials and methods

LITERATURE REVIEW. Yield and quality data for broccoli, cucumber, and sweet pepper varieties were collected through a systematic literature review. A meta-analysis of data extracted from the literature was conducted to produce relative yield and quality (if available) response values for each variety to indirectly assess performance across studies. The literature search was conducted using an academic search engine (Google Scholar; Google, Mountain View, CA); separate searches were conducted for each crop. Search terms included the common name of the crop plus “variety trial,” “cultivar evaluation,” “variety evaluation,” or “cultivar trial” in all fields. A separate search was conducted for each of these search terms. A general Internet search was also conducted for each crop using the common name of the crop plus “variety trial university extension” to capture extension publications that were not retrieved by the academic search engine. Reports from any publication year and location were included for consideration. These reports consisted of original refereed research articles, extension publications, theses and dissertations, and review article (if original data were included). Patents and citations were excluded.

Additional requirements for inclusion in the analysis were that the study: 1) included a third-party research partner (often university, extension, or non-profit; industry trials were excluded), 2) included at least three commercially available varieties, 3) presented data for yield and/or quality parameters, 4) was published in English or Spanish, and 5) full text was available online or through the University of Nebraska Library. The results were sorted by relevance and the first 300 search results were considered for each set of search terms. Searches were also conducted in several specific databases to complement the academic search engine and ensure

completeness; these included: U.S. Department of Agriculture (USDA) Current Research Information System (using “variety trial” AND “broccoli” OR “pepper” OR “cucumber” as search terms), eOrganic variety trial reports, and the Midwest Vegetable Trial Reports. We extracted data from a total of 288 sources for the meta-analysis (Supplemental File 1).

DATA EXTRACTION AND ANALYSIS. Yield and/or quality data were extracted from selected studies and coded by crop, variety, study year and location, growing environment (i.e., open field or hoophouse/high tunnel), and number of site-years. Data on soil texture were also recorded when available. A web-based tool (WebPlot Digitizer version 4.3; Automeris, Pacifica, CA) was used to extract and approximate data when presented in graphs. Data were later grouped according to crop and variety to produce sufficient replication for meta-analysis.

Data were extracted from three databases to compile coordinates, soil textures, and aridity index values (ratio of precipitation to evapotranspiration) for studies when they were not provided. A web-based tool was used to geocode study locations (Geocodio; Dotsquare, Arlington, VA). USDA soil texture classes for each study location were obtained from the International Soil Reference and Information Center’s Data Hub (Hengl et al., 2017) and global aridity index information was obtained from the Global Aridity Index dataset (Trabucco and Zomer, 2019). Soil texture and aridity index data were extracted using a geographic information system software (QGIS version 3.10; QGIS Project, Chicago, IL).

Response ratios for yield were determined for each variety within a study by dividing the yield of a particular variety by the average yield of all other varieties included in the study. If a cucumber variety was identified specifically as a pickling or slicing type, then the yield of that variety was only compared with the average yield of the same type (pickling or slicing) in that study. Response ratios were calculated for each discrete variety by site-year combination in a study and treated as independent observations within the meta-analysis. The response ratios were linearized, and normality was improved by taking the natural log of the response

ratios (Hedges et al., 1999). This process was also used to produce response ratios for quality for varieties when these data were available.

We enlisted a categorical bootstrapping approach for the meta-analysis because of the small sample size of our response groups (e.g., individual varieties) and the variability of methods (e.g., pest management, production system) used in studies included in the meta-analysis (Borenstein et al., 2009). Nonparametric bootstrap confidence intervals (95%) of yield and quality response ratios were calculated for varieties tested in a minimum of three distinct environments using a first-order normal distribution and 4999 iterations (“boot” package; R version 3.6.2; R Foundation, Vienna, Austria) (Adams et al., 1997). A total of 85 broccoli, 104 cucumber, and 144 sweet pepper varieties were included in the analysis for yield and/or quality. Yield and quality response ratios were back-transformed and reported as percentages relative to the mean yield of all other varieties in the analyzed studies. A mixed-effect meta-regression analysis was also conducted to explore the potential correlation between relative yield and aridity index when there were sufficient data available for an individual variety (“metafor” package, R version 3.6.2; R Foundation). A test to determine the heterogeneity of residuals was conducted (reported with Q_E statistic), and a test of moderators was conducted to determine the potential influence of the aridity index moderator on yield (reported with Q_M statistic) (Viechtbauer, 2010). We aimed to perform a categorical bootstrap analysis using soil textural classification as the moderator, but there was insufficient replication of soil texture within

varieties to explore the possible effects of soil texture on yield or quality.

Analysis of relative yield and quality among studies assumes that comparable yield and quality data collection methods were used across studies. However, variability in harvest timing and response variables measured is unavoidable and would contribute to random error in this meta-analysis. Similarly, calculating a relative yield and quality for varieties within studies is confounded by the other varieties included in that same study. This analysis assumes that the vast majority of variety trials compared vegetables of similar type and end use (e.g., slicing cucumbers, fall broccoli, or early peppers). Deviation from this assumption would contribute to random error and would be reflected in the size of confidence intervals around each relative mean.

VARIETY SELECTION DECISION-SUPPORT TOOL. Mean relative yield and quality values and their corresponding 95% bootstrap confidence intervals were integrated into an online decision-support tool called the Vegetable Variety Navigator (Wortman and Loker, 2020). This tool allows growers and other users to view relative yield and quality data via interactive charts and maps hosted by a data visualization platform (Tableau Public version 2020.3.0; Tableau Software, Mountain View, CA). These data can help growers decide the best variety for their operation, in combination with other personal decision-making factors, such as pest resistance, time to maturity, and local availability.

The Vegetable Variety Navigator consists of two main sections: graphical summaries of mean relative yield and quality potentials (Fig. 1) and a dynamic map (Fig. 2). The graphical summaries can help users compare the

relative yield or quality potentials of various broccoli, cucumber, and sweet pepper varieties by selecting multiple varieties of interest from the right-side menu bar. Additional information is provided in a pop-up box that appears when a user hovers over a data point. Data from all studies are also presented in map-form to allow users to explore possible relationships among yield and quality, region, soil texture, and aridity index. The map section also allows users to view individual study data for varieties that were not included in the relative yield/quality potential calculations (found in the graphical summaries) because of insufficient distinct environments (i.e., fewer than three). Citations for individual studies are also available in the map view to allow users to view details about the experimental design and other information of interest. Users may also use the filters on the right-side menu bar to narrow results by crop, variety, soil texture, and/or aridity index (Fig. 2) to obtain results most relevant to their farms.

Results and discussion

RELATIVE YIELD AND QUALITY. Varieties were categorized as having low, moderate, or high relative yield/quality potentials based on their confidence intervals and color-coded to succinctly communicate these results to users (Table 1). Varieties with confidence intervals that only included a range of values less than zero were categorized as having low relative yield or quality potential. These varieties performed consistently worse than the others included in a trial for direct comparison. Varieties with confidence intervals that contained only values greater than zero were categorized as having high relative yield or quality potential; these varieties consistently

Table 1. Parameters for determination and identification of low, moderate, and high relative yield or quality potential in the Vegetable Variety Navigator and the relative proportion of varieties identified as such for broccoli, cucumber, and pepper.

Potential	Confidence interval bounds	Color in online tool	Relative proportion of varieties (%)					
			Broccoli		Cucumber		Pepper	
			Yield	Quality	Yield	Quality	Yield	Quality
Low relative yield/quality	<0	Blue	22	11	25	9	17	13
Moderate relative yield/quality	Contains 0	Gray	72	75	66	84	69	74
High relative yield/quality	>0	Orange	6	13	9	7	15	12

Fig. 1. A screenshot of the user interface for the graphical summaries section of the Vegetable Variety Navigator. Users can visualize the mean and 95% confidence interval for relative yield and quality potential for broccoli, cucumber, and pepper variety data. Varieties were categorized as having low (blue), moderate (gray), or high (orange) relative yield or quality potential depending on performance relative to other varieties in trials included in the analysis.

Fig. 2. A screenshot of the user interface for the mapping section of the Vegetable Variety Navigator. Users can visualize the differences in relative yield and quality means for broccoli, cucumber, and pepper varieties across locations, climates, and soil textures. The relative size of each data point provides information about the number of locations and years (i.e., site-years) contributing to the calculated mean (larger dots indicate more replication). The shade of green of each data point indicates the relative performance of that variety among locations on the map (darker green dots indicate better performance).

outperformed others included in the same study. The most common classification was moderate relative yield or quality potential, which included those varieties with a confidence interval range including zero. These varieties did not perform significantly better or worse than the peer varieties from the same trial. The percentages of varieties categorized as having low, moderate, or high yield and quality potentials for each crop are summarized in Table 1. The number and size of categories are not absolute; instead, they are intended to aid the interpretation of meta-analysis results for end-users.

The range of the confidence interval can be interpreted as the adaptability of a particular variety. Varieties with smaller ranges are assumed to be more widely adapted than those with larger ranges. For example, a confidence interval with a smaller range indicates more consistent performance across environments than an interval with a large range. Growers can use this adaptability information in conjunction with the relative yield or quality potentials to select suitable varieties for their operations with consideration for their own thresholds for risk (i.e., broadly adapted varieties are less risky, but narrowly adapted varieties may perform exceptionally well in very specific locations).

Among 69 broccoli varieties analyzed for yield, Green Gold, Galaxy, Liberty, and BC 1691 were consistently high-yielding. In contrast, the highest-quality broccoli varieties (among 57 analyzed for quality) were Emerald Pride, Lieutenant, Southern Comet, Patriot, Luna, Windsor, and Packman (Supplemental Table 1). No broccoli varieties were identified as both reliably high-yielding and high-quality across environments. Of the 99 cucumber varieties analyzed for yield, Alibi, Liszt, Expedition, Journey, Socrates, Tasty Jade, EarliPik 14, Pik Rite, Sprint 440, and Score had high relative yield potential. The quality potential among 72 analyzed cucumber varieties was less variable but consistently above average for Eureka, Journey, Dasher II, Speedway, Calypso, Sprint 440, Spear It, and Amour (Supplemental Table 2). Interestingly, the mean relative yield potential was less than 0% for six of these eight high-quality cucumber varieties, highlighting the common tradeoff between crop yield and quality (Benbrook, 2009). Among

134 sweet pepper varieties analyzed for yield, 19 were identified as consistently high-yielding; those varieties included Ace, New Ace, Flamingo, Sweet Chocolate, Red Dawn, Colossal, Argo, Lady Bell, Honeybelle, Turnpike, Green Boy, Antebellum, Domino, Declaration, Sentry, Charisma, Excursion II, Boca, and PS 0994-1819. Sweet pepper varieties exhibiting consistently high quality (out of 111 analyzed) included Ma Belle, Snapper, Wizard, Belle Star, Four Corners, Currier, Alliance, Legionnaire, Patriot, Archimedes, Declaration, Heritage, Classic, and Outsider (Supplemental Table 3). Only ‘Declaration’ was identified as consistently high-yielding and high-quality (14 observations across 13 studies).

RELATIONSHIP BETWEEN ARIDITY AND RELATIVE YIELD. A meta-regression was conducted to identify potential correlation between global aridity index (annual average 1970–2000) and relative yield data. Overall, results suggest that global aridity index is not a consistently useful explanatory variable for relative yield of broccoli, cucumber, or sweet pepper varieties across time and space. A significant relationship between aridity and relative yield was observed for one broccoli variety (HMX 4138: $Q_M = 8.435$, $P < 0.01$), three cucumber varieties (Indy: $Q_M = 9.105$, $P < 0.01$; Darlington: $Q_M = 6.568$, $P = 0.01$; Pik Rite: $Q_M = 4.071$, $P = 0.04$), and one sweet pepper variety (Blushing Beauty: $Q_M = 15.878$, $P < 0.001$). However, the direction of the correlation between the aridity index and relative yield was not consistent among varieties, and the number of site-years contributing to these relationships was relatively small. It is noteworthy that the number of significant correlations—only 5 out of 291 tested (1.7%)—was within the expected rate of spurious correlation or “false positives” (the margin of type I error is typically equal to the significance level, which, in this case, was 5%). The overwhelming lack of significant correlations and the inevitability of type I error seem to suggest that the aridity index is not a useful predictor of relative yield performance for broccoli, cucumber, or sweet pepper.

These results are similar to those of Kheiri et al. (2017), who did not observe a significant correlation between the annual aridity index and dryland wheat yield but did observe

significant relationships between the seasonal aridity index and yield at only some stations. However, during an earlier study, Bannayan et al. (2010) found a positive correlation between the annual aridity index and yield for rainfed wheat and barley (*Hordeum vulgare*) in Iran. A significant correlation between the aridity index and yield on a seasonal scale was also observed at several sites during the wet season (Bannayan et al., 2010). Of the varieties for which a significant relationship between global aridity index and yield was observed during our meta-regression, only one study was conducted under rainfed conditions; the remaining studies performed irrigation or did not specify whether irrigation was used. Therefore, it is possible that the prevalent use of irrigation during the studies included in the meta-regression (and, more generally, for vegetable crops) affected the potential relationship between aridity and yield (more commonly observed in nonirrigated field crops). The lack of a significant relationship may also indicate that most commercially available varieties (like those included in this meta-analysis) are broadly adapted to diverse arid and humid environments.

EXAMPLE APPLICATION OF THE VEGETABLE VARIETY NAVIGATOR. Assume that vegetable growers near Lincoln, NE, are searching for a new cucumber variety for their farms. In addition to recommendations from seed companies, fellow growers, and Extension resources, the growers can now consult the Vegetable Variety Navigator to find a visual summary of all public yield and quality data for any varieties they may be considering (excluding newly released varieties for which public variety trial data are not yet available). After consulting local vegetable variety recommendations from the University of Nebraska Extension (Browning and Hodges, 2008), these growers have narrowed their search to Marketmore 76 and Dasher II.

A comparison of these two varieties in the graphical section of the tool (Fig. 1) revealed that Marketmore 76 is relatively low-yielding (mean relative yield of -70%) compared with Dasher II, which has moderate yield potential (mean relative yield of -1% compared with its competitors) (Supplemental Table 1). Moreover, ‘Dasher II’ has exhibited average to above-average

quality (ranging from 0% to 42% relative quality compared with competitors), whereas the quality of ‘Marketmore 76’ is consistently average (–5% to 8% quality change relative to competitors). Next, the growers would be advised to consult the map section of the tool (Fig. 2) to explore results for each variety across specific locations.

Using “proximity to Lincoln, Nebraska” as the criteria for evaluation, the growers would find 3 site-years of data for ‘Marketmore 76’ in Wisconsin and 2 site-years of data in Ohio. In these locations, the average relative yield potential for ‘Marketmore 76’ ranged from 7% to 20%, which is much greater than the range identified through the global dataset (an exploration of data from the southeast region of the United States helps explain the relatively low global yield estimate for ‘Marketmore 76’). Relative quality from these nearby locations ranged from –7% to 2% for ‘Marketmore 76’, which is consistent with its global range. Data for ‘Dasher II’ in closest proximity to Lincoln, NE, include 1 site-year each from Missouri, Oklahoma, and Kentucky, and 2 site-years from Michigan. Across these locations, the average relative yield potential of ‘Dasher II’ ranged from –25% to 49%. Relative quality was available for only 2 site-years and ranged from 1% to 188% (compared with a global mean of 17%).

This mapping exercise suggests that the Nebraska extension guide provides relatively accurate recommendations for ‘Marketmore 76’ and ‘Dasher II’ (based on data from the nearest locations), and both are likely acceptable varieties for these growers. ‘Dasher II’ seems to have greater yield and quality potential, but it may be less adaptable to specific conditions throughout the midwestern United States compared with ‘Marketmore 76’. However, the broader adaptability of ‘Dasher II’ beyond the midwestern United States (exhibited by its global relative yield range) may be beneficial considering the increasingly volatile and unpredictable weather associated with climate change. Finally, these growers could assign a weighted value to the results from specific locations based on latitude (as a proxy for important factors like daylength and nighttime temperatures), soil texture, or

aridity index instead of solely depending on proximity to Lincoln, NE.

Conclusions

Variety trial data are critically important to vegetable growers but are increasingly difficult to source and extrapolate across production regions. The Vegetable Variety Navigator decision-support tool aims to synthesize an otherwise overwhelming amount of variety trial data into a user-friendly web tool for growers that is intended to complement, not replace, existing sources of information about local variety performance. The Vegetable Variety Navigator will be periodically updated with data from new trials, and a subset of varieties will be ground-truthed in 2021 and 2022 through local on-farm variety trials in Nebraska. Users may also submit new variety trial data for consideration through the Vegetable Variety Navigator website to ensure that the database is accurate and complete. Finally, we anticipate adding additional locally important vegetable crops to the tool in the future, including tomato, sweet corn (*Zea mays*), and pumpkin (*Cucurbita* sp.).

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Supplemental File 1

Studies included in the meta-analysis and online decision-support tool.

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Supplemental Table 1. Tabulation of meta-analysis results for 85 broccoli varieties including mean relative yield and quality potential, lower and upper relative yield and quality potential (determined by the lower and upper bounds of the 95% confidence intervals around the mean), and the number of site-years and studies contributing to each estimate. Varieties are arranged in order of greatest (top) to lowest (bottom) mean relative yield. These data are also presented visually in the graphical summaries section of the Vegetable Variety Navigator. An “N/A” in an individual cell indicates insufficient replication for inclusion in the meta-analysis (less than three site-years).

Variety	Mean relative yield potential (%)	Lower relative yield potential (%)	Upper relative yield potential (%)	Site-years (no.)	Studies (no.)	Mean relative quality potential (%)	Lower relative quality potential (%)	Upper relative quality potential (%)	Site-years (no.)	Studies (no.)
Green Gold	27	5	51	15	6	N/A	N/A	N/A	N/A	N/A
Lucky	19	-3	46	6	3	N/A	N/A	N/A	N/A	N/A
Greenbelt	17	-17	51	6	3	-19	-34	3	17	10
Emerald Crown	16	0	35	17	9	8	-2	20	12	8
Galaxy	16	9	23	3	3	10	-15	41	8	5
Batavia	16	-2	38	13	6	-3	-16	13	5	5
Chevalier	15	-7	42	3	3	N/A	N/A	N/A	N/A	N/A
Southern Comet	15	-5	38	4	4	21	5	36	5	5
Green Valient	14	-21	89	9	4	N/A	N/A	N/A	N/A	N/A
Legacy	14	-9	45	6	4	-4	-27	27	6	4
Liberty	13	2	26	9	5	-26	-50	4	10	9
General	12	-4	29	8	4	N/A	N/A	N/A	N/A	N/A
BC 1691	11	4	18	9	3	N/A	N/A	N/A	N/A	N/A
Cape Queen	9	-24	64	3	3	N/A	N/A	N/A	N/A	N/A
Imperial	8	-3	20	50	14	4	-8	17	25	11
Green Magic	8	-5	23	41	20	8	-1	18	25	15
Major	8	-21	44	7	6	6	-1	14	5	4
Regal	7	-9	23	19	5	-11	-34	31	8	4
Green Goliath	7	-14	36	18	6	3	-19	25	9	4
Neptune	6	-27	58	3	3	9	-9	31	5	3
Majestic	5	-30	60	7	3	N/A	N/A	N/A	N/A	N/A
Luna	4	-12	23	13	6	18	11	26	13	6
Lieutenant	3	-6	13	13	5	24	7	44	11	4
Durapak 16	2	-6	11	11	3	N/A	N/A	N/A	N/A	N/A
Emperor	1	-14	21	10	7	-24	-42	1	19	9
Pinnacle	1	-4	5	5	3	-12	-29	7	12	7
Barbados	1	-23	29	7	5	0	-9	8	6	4
Cruiser	-1	-13	13	6	5	6	-8	23	14	9
Windsor	-2	-23	24	17	11	17	7	28	20	10
Fiesta	-4	-15	9	28	12	-1	-9	7	10	7
Premium Crop	-4	-14	8	24	13	9	-2	22	13	10
Parthenon	-4	-15	9	6	4	N/A	N/A	N/A	N/A	N/A
Laguna	-7	-40	46	4	3	9	-1	19	6	5
Green Comet	-8	-30	23	5	3	N/A	N/A	N/A	N/A	N/A
Gypsy	-8	-25	12	52	21	-2	-33	44	44	18
Captain	-9	-30	18	17	11	0	-10	10	10	8
Apollo	-10	-39	33	4	3	N/A	N/A	N/A	N/A	N/A
Green Duke	-10	-38	31	5	4	5	-14	27	16	7
Arcadia	-10	-26	2	46	17	7	-4	19	30	14
Patron	-11	-26	8	20	9	4	-20	32	11	7
Castle Dome	-11	-33	13	4	4	N/A	N/A	N/A	N/A	N/A
Claudia	-12	-57	80	3	2	N/A	N/A	N/A	N/A	N/A
Burney	-12	-22	0	11	3	N/A	N/A	N/A	N/A	N/A
Packman	-14	-22	-5	34	14	16	2	32	26	14
Excelsior	-14	-37	10	16	4	-6	-26	20	9	6
Patriot	-15	-26	-2	11	4	20	7	34	3	3
Signal	-15	-61	82	4	3	N/A	N/A	N/A	N/A	N/A
Destiny	-16	-44	24	6	4	N/A	N/A	N/A	N/A	N/A
Diplomat	-16	-26	-5	25	9	11	-4	27	15	8

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Supplemental Table 1. (Continued).

Variety	Mean relative yield potential (%)	Lower relative yield potential (%)	Upper relative yield potential (%)	Site- years (no.)	Studies (no.)	Mean relative quality potential (%)	Lower relative quality potential (%)	Upper relative quality potential (%)	Site- years (no.)	Studies (no.)
Sultan	-17	-27	-2	15	6	7	-2	17	11	8
Marathon	-17	-37	9	38	17	-12	-22	-1	18	10
Everest	-17	-38	10	22	10	5	-4	15	14	10
Paragon	-18	-23	-12	5	3	2	1	3	5	3
Excalibur	-18	-28	-10	8	3	N/A	N/A	N/A	N/A	N/A
Heritage	-18	-36	5	7	3	0	-16	16	6	5
Belle Star	-20	-35	-1	42	16	-15	-33	6	25	10
Goliath	-20	-24	-16	5	3	N/A	N/A	N/A	N/A	N/A
Emerald Pride	-22	-39	0	3	3	66	36	107	3	3
Avenger	-24	-59	32	11	4	-58	-72	-37	12	5
Amadeus	-24	-34	-13	10	3	N/A	N/A	N/A	N/A	N/A
Ironman	-25	-47	5	11	7	N/A	N/A	N/A	N/A	N/A
Galleon	-30	-46	-13	3	3	-16	-26	-5	4	4
Bay Meadows	-31	-56	0	6	6	N/A	N/A	N/A	N/A	N/A
Emerald Jewel	-35	-53	-12	11	4	N/A	N/A	N/A	N/A	N/A
Monaco	-51	-85	26	4	3	N/A	N/A	N/A	N/A	N/A
Expo	-56	-88	43	11	3	N/A	N/A	N/A	N/A	N/A
Blue Wind	-56	-83	2	12	5	N/A	N/A	N/A	N/A	N/A
Shogun	-61	-91	68	3	3	N/A	N/A	N/A	N/A	N/A
Early Dividend	-89	-96	-65	3	3	N/A	N/A	N/A	N/A	N/A
Zeus	N/A	N/A	N/A	N/A	N/A	24	-10	70	3	3
Alborada	N/A	N/A	N/A	N/A	N/A	14	-10	56	4	4
Legend	N/A	N/A	N/A	N/A	N/A	6	-10	26	5	4
Sprinter	N/A	N/A	N/A	N/A	N/A	5	-20	38	4	4
Schooner	N/A	N/A	N/A	N/A	N/A	-1	-15	16	10	5
Buccaneer	N/A	N/A	N/A	N/A	N/A	-1	-26	36	6	5
Headline	N/A	N/A	N/A	N/A	N/A	-1	-12	16	4	4
Triathlon	N/A	N/A	N/A	N/A	N/A	-1	-12	12	8	4
Vantage	N/A	N/A	N/A	N/A	N/A	-5	-27	21	6	3
Skiff	N/A	N/A	N/A	N/A	N/A	-6	-23	13	13	6
Rosalind	N/A	N/A	N/A	N/A	N/A	-12	-35	19	3	3
FMX 94	N/A	N/A	N/A	N/A	N/A	-22	-48	14	5	3
Citation	N/A	N/A	N/A	N/A	N/A	-24	-40	-4	6	4
HMX 4138	N/A	N/A	N/A	N/A	N/A	-24	-47	3	5	3
Pirate	N/A	N/A	N/A	N/A	N/A	-28	-46	-4	9	4
Commander	N/A	N/A	N/A	N/A	N/A	-43	-63	-18	11	6

Supplemental Table 2. Tabulation of meta-analysis results for 104 cucumber varieties including mean relative yield and quality potential, lower and upper relative yield and quality potential (determined by the lower and upper bounds of the 95% confidence intervals around the mean), and the number of site-years and studies contributing to each estimate. Varieties are arranged in order of greatest (top) to lowest (bottom) mean relative yield. These data are also presented visually in the graphical summaries section of the Vegetable Variety Navigator. An “N/A” in an individual cell indicates insufficient replication for inclusion in the meta-analysis (less than three site-years).

Variety	Mean relative yield potential (%)	Lower relative yield potential (%)	Upper relative yield potential (%)	Site-years (no.)	Studies (no.)	Mean relative quality potential (%)	Lower relative quality potential (%)	Upper relative quality potential (%)	Site-years (no.)	Studies (no.)
Alibi	66	30	111	14	7	9	-3	22	9	5
M 21	61	-20	278	37	5	10	-21	56	28	3
Liszt	38	29	49	4	4	1	-4	7	3	3
Atlantis	36	-3	92	9	7	-7	-16	1	4	4
Expedition	36	17	56	8	6	21	-6	56	5	5
Journey	36	11	67	5	3	18	9	27	3	3
Lafayette	35	-7	99	6	4	-1	-24	29	3	3
Palomino	29	-2	71	5	3	N/A	N/A	N/A	N/A	N/A
Tasty Green	29	-23	116	16	10	9	-5	24	9	7
Socrates	26	14	38	7	6	0	-5	6	4	3
Tasty Jade	22	7	38	8	5	-5	-15	3	6	5
Earlipik 14	21	4	40	27	3	14	-1	32	27	3
Pik Rite	20	6	35	5	5	-7	-12	-2	3	3
Sprint 440	20	9	31	9	6	12	0	25	8	5
Score	19	1	39	8	6	0	-5	5	5	4
Regal	18	-1	38	33	4	2	-33	60	28	5
Rubinstein	18	-5	47	3	3	N/A	N/A	N/A	N/A	N/A
Beit Alpha	16	-22	73	10	5	N/A	N/A	N/A	N/A	N/A
Fancipak	16	-12	49	11	8	3	-5	12	4	4
Talladaga	14	-18	59	5	3	N/A	N/A	N/A	N/A	N/A
Vlaspik	13	-12	46	10	8	5	-9	21	7	6
Gershwin	11	-7	32	7	7	0	-5	4	5	5
Super Marketer	11	-25	50	7	3	N/A	N/A	N/A	N/A	N/A
USACX 10428	11	-7	31	5	4	12	-1	26	5	4
Sweet Success	10	-25	52	6	5	N/A	N/A	N/A	N/A	N/A
Carolina	9	-9	30	44	15	7	-1	16	32	7
Cherokee	9	-27	48	6	3	N/A	N/A	N/A	N/A	N/A
Duke	9	-2	20	5	5	2	-13	19	3	3
Flurry	8	-18	45	10	6	3	-3	9	5	4
Tamor	7	-3	18	8	5	2	-5	9	6	3
Thunder	7	-6	22	9	6	-6	-17	6	4	3
Manny	6	-10	27	5	3	-8	-12	-4	4	3
Lisboa	5	-4	17	8	6	-5	-16	9	7	6
General Lee	4	-7	16	9	7	13	-10	42	5	4
Greensleeves	3	-20	31	6	4	28	-5	68	3	3
Rockingham	3	-7	14	4	4	N/A	N/A	N/A	N/A	N/A
Sassy	3	-22	37	9	5	5	-9	22	6	5
Dominator	2	-10	17	4	4	N/A	N/A	N/A	N/A	N/A
Feisty	2	-30	49	6	6	-18	-44	19	4	3
Pioneer	2	-18	26	32	6	6	-5	19	29	3
Superior	2	-7	12	4	4	2	-5	10	6	5
Genuine	1	-12	17	5	5	N/A	N/A	N/A	N/A	N/A
Speedway	1	-13	17	8	7	21	3	40	4	4
Cobra	-1	-6	4	11	11	-2	-6	2	8	7
Dasher II	-1	-13	14	27	18	19	0	42	13	13
SV 3462 CS	-1	-18	20	5	5	-6	-20	10	4	3
SV 4719 CS	-1	-13	13	11	8	-2	-8	5	6	5
Bowie	-2	-16	13	6	6	-3	-10	5	4	4
Artist	-3	-16	11	6	5	2	-5	8	4	4
SX 2387 CW	-4	-13	9	3	3	N/A	N/A	N/A	N/A	N/A

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Supplemental Table 2. (Continued).

Variety	Mean relative yield potential (%)	Lower relative yield potential (%)	Upper relative yield potential (%)	Site- years (no.)	Studies (no.)	Mean relative quality potential (%)	Lower relative quality potential (%)	Upper relative quality potential (%)	Site- years (no.)	Studies (no.)
Poinsett	-7	-21	9	12	6	N/A	N/A	N/A	N/A	N/A
Triplemech	-9	-31	22	9	6	-3	-8	1	7	4
Darlington	-11	-17	-4	5	6	2	-10	18	5	5
Diomedea	-11	-21	1	5	6	-10	-18	-1	7	6
Northern Pickling	-11	-46	34	6	5	N/A	N/A	N/A	N/A	N/A
Intimidator	-12	-30	10	9	7	28	-5	69	3	3
Impact	-13	-24	-2	8	7	8	-3	21	6	5
Salad Bush	-13	-36	17	3	3	N/A	N/A	N/A	N/A	N/A
Calypso	-14	-41	26	53	10	18	9	27	40	11
Indy	-14	-49	47	9	9	19	-1	41	4	4
Spear It	-19	-33	-1	5	5	4	0	8	5	5
Addis	-20	-32	-6	24	1	N/A	N/A	N/A	N/A	N/A
Napoleon	-20	-49	26	4	3	-3	-14	10	4	3
RZ 11	-21	-51	31	3	3	N/A	N/A	N/A	N/A	N/A
Yamato Sanjaku	-21	-39	3	5	3	-55	-81	1	3	3
Marketer	-24	-34	-13	7	4	N/A	N/A	N/A	N/A	N/A
Vlasset	-25	-58	32	6	4	N/A	N/A	N/A	N/A	N/A
Bounty	-26	-47	3	9	3	0	-4	5	8	3
HMX 0469	-26	-34	-17	3	3	N/A	N/A	N/A	N/A	N/A
Yildo	-26	-36	-14	4	2	4	-7	14	3	3
Ashley	-32	-61	24	25	12	-32	-81	99	3	3
Martini	-33	-78	102	10	4	-43	-87	155	6	4
Clinton	-35	-43	-25	27	3	-27	-36	-16	28	4
Panther	-36	-61	4	5	3	N/A	N/A	N/A	N/A	N/A
Tyria	-36	-53	-10	5	4	5	-15	32	4	3
Stonewall	-37	-59	-4	9	7	4	-10	21	5	5
Diva	-38	-53	-17	12	10	-18	-30	-3	6	5
Olympian	-41	-79	56	5	5	N/A	N/A	N/A	N/A	N/A
Palmetto	-41	-73	63	6	3	N/A	N/A	N/A	N/A	N/A
Amour	-43	-61	-20	5	5	4	2	6	4	4
Sumter	-44	-67	-5	37	6	-34	-45	-21	29	4
Turbo	-44	-78	37	4	4	-8	-20	6	3	3
Poinsett 76	-45	-71	9	17	10	4	-8	18	9	6
Eureka	-51	-84	44	9	9	18	9	27	4	4
Sultan	-53	-58	-48	3	3	N/A	N/A	N/A	N/A	N/A
Japanese Climbing	-59	-82	-5	5	4	N/A	N/A	N/A	N/A	N/A
Cross Country	-63	-90	30	9	7	8	-3	22	5	5
Marketmore 76	-70	-85	-41	36	21	2	-5	8	16	10
Fanfare	-76	-91	-39	7	5	N/A	N/A	N/A	N/A	N/A
SMR 58	-76	-94	-8	7	5	-16	-29	0	3	3
Wautoma	-76	-92	-28	27	2	N/A	N/A	N/A	N/A	N/A
Sweeter Yet	-80	-95	-23	3	3	N/A	N/A	N/A	N/A	N/A
WI 2238	-82	-98	38	5	4	N/A	N/A	N/A	N/A	N/A
WI 2757	-84	-93	-63	31	4	N/A	N/A	N/A	N/A	N/A
SMR 18	-88	-93	-79	35	4	N/A	N/A	N/A	N/A	N/A
WI SMR 18	-89	-94	-79	33	4	N/A	N/A	N/A	N/A	N/A
H-19 (Little Leaf)	-92	-99	-35	10	7	N/A	N/A	N/A	N/A	N/A
Straight Eight	-97	-99	-79	13	7	0	-9	11	4	3
Ansor	N/A	N/A	N/A	N/A	N/A	0	-2	3	3	3
Discover M	N/A	N/A	N/A	N/A	N/A	16	-7	43	4	3
Flurry M	N/A	N/A	N/A	N/A	N/A	1	-5	6	3	3
Premier	N/A	N/A	N/A	N/A	N/A	-4	-11	6	4	4
USACX 10429	N/A	N/A	N/A	N/A	N/A	9	-11	34	5	4

Supplemental Table 3. Tabulation of meta-analysis results for 144 pepper varieties including mean relative yield and quality potential, lower and upper relative yield and quality potential (determined by the lower and upper bounds of the 95% confidence intervals around the mean), and the number of site-years and studies contributing to each estimate. Varieties are arranged in order of greatest (top) to lowest (bottom) mean relative yield. These data are also presented visually in the graphical summaries section of the Vegetable Variety Navigator. An “N/A” in an individual cell indicates insufficient replication for inclusion in the meta-analysis (less than three site-years).

Variety	Mean relative yield potential (%)	Lower relative yield potential (%)	Upper relative yield potential (%)	Site-years (no.)	Studies (no.)	Mean relative quality potential (%)	Lower relative quality potential (%)	Upper relative quality potential (%)	Site-years (no.)	Studies (no.)
Ace	63	27	109	14	11	-66	-90	13	5	3
Tequila	58	-40	346	14	7	N/A	N/A	N/A	N/A	N/A
New Ace	47	6	107	10	7	19	-2	43	7	7
Flamingo	30	18	43	3	3	-5	-17	8	4	3
Sweet Chocolate	30	12	51	5	3	5	-3	15	21	6
Red Dawn	30	4	61	3	3	10	2	18	16	14
Colossal	29	9	55	5	4	-1	-7	6	5	5
Argo	21	13	30	3	3	-12	-27	10	5	5
Lady Bell	18	8	30	13	12	-8	-28	16	4	3
Honeybelle	18	2	38	3	3	8	-2	20	12	10
Vivaldi	17	-18	65	6	4	-52	-70	-25	7	6
Turnpike	17	0	36	7	6	-20	-47	20	8	7
Green Boy	16	11	21	4	4	-5	-9	-1	3	3
Antebellum	16	1	34	4	3	-11	-35	21	3	3
Domino	14	1	29	5	5	-2	-18	21	4	4
North Star	14	-3	35	10	8	6	0	11	3	3
Declaration	14	7	22	17	16	-40	-57	-15	9	4
Boynton Bell	13	0	29	22	13	N/A	N/A	N/A	N/A	N/A
Mayata	13	-11	40	3	3	-7	-13	-2	3	3
Bell King	13	-7	37	5	5	7	-8	25	9	6
La Belle	13	-5	33	3	2	N/A	N/A	N/A	N/A	N/A
Enterprise	12	-2	28	8	6	10	0	21	32	21
Sentry	11	3	21	3	3	N/A	N/A	N/A	N/A	N/A
Merlin	10	-1	22	6	6	N/A	N/A	N/A	N/A	N/A
Hybelle	10	-4	24	6	6	-10	-25	8	5	5
Lafayette	9	-3	23	14	13	1	-9	11	19	13
Karisma	9	4	15	28	24	-4	-5	-3	4	3
Excursion II	9	4	14	15	12	-10	-23	2	3	3
Chesapeake	8	-4	25	3	3	-13	-28	11	4	4
Early Red Sweet	8	-6	26	6	3	18	0	44	4	4
Galileo	8	-3	19	4	4	-9	-24	10	4	3
Bell Boy	8	-6	24	7	7	-6	-18	13	4	4
Gedeon	7	-2	18	3	3	-18	-32	3	3	3
Shamrock	7	-14	34	4	4	12	-3	26	3	3
Boca	7	2	11	6	5	-6	-21	14	3	3
Staddon Select	6	-3	17	5	5	-17	-28	-5	4	4
PS 0994-1819	6	1	11	13	11	-14	-28	1	6	5
Blitz	5	-4	15	9	8	1	-7	9	26	22
Vanguard	5	0	11	26	24	N/A	N/A	N/A	N/A	N/A
Gridiron	5	-5	16	7	5	19	11	27	12	9
Currier	5	-3	13	11	11	N/A	N/A	N/A	N/A	N/A
Telestar	5	-3	13	7	6	N/A	N/A	N/A	N/A	N/A
Lantern	5	-4	13	8	3	-4	-18	12	6	5
Sandpiper	4	-8	17	3	3	-24	-38	-10	7	6
Big Belle	4	-2	11	4	4	-6	-22	14	9	9
SV 3255 PB	4	-3	10	5	5	-8	-15	2	3	3
Belle Star	3	-5	14	3	3	-1	-19	23	6	5
MA 79259	3	-5	12	3	3	N/A	N/A	N/A	N/A	N/A
8302	2	-26	42	5	3	19	-7	52	10	8

(Continued on next page)

Supplemental Table 3. (Continued).

Variety	Mean relative yield potential (%)	Lower relative yield potential (%)	Upper relative yield potential (%)	Site- years (no.)	Studies (no.)	Mean relative quality potential (%)	Lower relative quality potential (%)	Upper relative quality potential (%)	Site- years (no.)	Studies (no.)
Tom Cat	2	-4	9	10	9	N/A	N/A	N/A	N/A	N/A
Alliance	2	-10	15	41	28	-4	-14	7	7	5
Mecate	1	-11	14	5	5	14	-4	36	40	21
Green Machine	1	-4	6	5	4	16	5	31	5	5
Skipper	1	-15	21	4	4	-5	-14	5	8	8
4 Star	1	-18	18	6	5	-37	-53	-16	5	3
ACX 238	1	-4	6	4	4	39	-15	179	3	3
Rebell	0	-5	5	3	3	N/A	N/A	N/A	N/A	N/A
Orion	0	-6	6	10	9	-5	-27	26	6	5
Bell Tower	-1	-5	3	3	3	N/A	N/A	N/A	N/A	N/A
Sprinter	-2	-19	18	8	6	N/A	N/A	N/A	N/A	N/A
Cutlass	-2	-14	10	4	4	15	0	31	10	10
Four Corners	-3	-15	11	5	5	N/A	N/A	N/A	N/A	N/A
Wizard	-3	-11	6	12	9	-18	-37	10	5	5
Polaris	-3	-10	5	11	6	12	-3	31	8	8
King Arthur	-4	-19	15	41	28	N/A	N/A	N/A	N/A	N/A
Brigadier	-4	-19	14	18	14	-3	-23	22	4	4
Snapper	-5	-13	5	9	5	-40	-69	16	38	27
Melody	-5	-17	7	4	4	11	-2	28	6	6
Touchdown	-6	-18	9	5	4	N/A	N/A	N/A	N/A	N/A
Intruder	-6	-12	1	22	19	N/A	N/A	N/A	N/A	N/A
Aristotle	-6	-14	3	101	63	-9	-30	19	8	7
Double Up	-6	-20	11	11	8	N/A	N/A	N/A	N/A	N/A
Playmaker	-6	-18	8	5	4	-10	-23	6	10	10
Marengo	-6	-27	20	4	4	N/A	N/A	N/A	N/A	N/A
Red Bull	-7	-21	10	8	3	-27	-50	5	4	3
9325	-7	-18	5	5	4	-57	-84	5	12	5
Hunter	-7	-15	1	9	9	25	5	49	9	5
Rampart	-7	-19	6	5	5	-7	-16	3	5	4
Hercules	-7	-26	15	4	3	4	-9	20	10	5
Socrates	-7	-17	2	21	14	24	-22	106	3	3
Iron Sides	-8	-30	23	8	6	-3	-15	11	20	17
Karma	-8	-17	2	9	7	-6	-11	-1	5	5
Alexandra	-8	-16	1	4	3	-10	-18	0	14	13
Archimedes	-8	-32	25	21	18	N/A	N/A	N/A	N/A	N/A
Annabelle	-8	-28	19	3	3	N/A	N/A	N/A	N/A	N/A
Valley Giant	-8	-21	7	3	3	-64	-91	32	19	9
Revolution	-9	-22	8	51	29	N/A	N/A	N/A	N/A	N/A
Emerald Giant	-9	-19	3	6	6	N/A	N/A	N/A	N/A	N/A
Golden Sun	-9	-22	7	4	3	-13	-25	2	4	4
Flavorburst	-9	-50	63	15	11	-16	-20	-12	5	5
Bastille	-9	-21	4	8	8	-4	-20	15	18	11
Classic	-10	-16	-3	3	3	14	0	30	5	4
Summer Sweet 830	-10	-22	4	5	3	N/A	N/A	N/A	N/A	N/A
Aladdin	-10	-32	19	6	5	-19	-32	-5	3	3
Conquest	-10	-19	-1	8	6	26	-13	79	6	5
Valencia	-11	-34	21	5	5	-44	-67	-2	6	5
Legionnaire	-11	-27	9	20	15	-1	-15	15	7	5
Bayonet	-11	-15	-7	12	12	7	-9	27	4	4
Super Set	-11	-27	7	7	7	N/A	N/A	N/A	N/A	N/A
Islamorada	-12	-24	1	6	6	-17	-41	16	78	47
	-12	-25	4	7	6	N/A	N/A	N/A	N/A	N/A

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Supplemental Table 3. (Continued).

Variety	Mean relative yield potential (%)	Lower relative yield potential (%)	Upper relative yield potential (%)	Site- years (no.)	Studies (no.)	Mean relative quality potential (%)	Lower relative quality potential (%)	Upper relative quality potential (%)	Site- years (no.)	Studies (no.)
Keystone Resistant Giant										
Midway	-12	-37	21	6	6	-31	-60	20	6	5
Commandant	-13	-35	16	12	9	N/A	N/A	N/A	N/A	N/A
Abay	-14	-25	0	4	4	11	-13	43	3	3
Better Belle	-14	-33	10	4	3	-8	-19	5	5	5
Patriot	-15	-28	0	20	18	-22	-37	-3	4	4
Heritage	-15	-36	13	12	12	-11	-24	4	30	19
Paladin	-16	-29	-1	69	27	-11	-21	1	9	6
Enforcer	-17	-27	-5	3	3	-5	-17	8	10	9
Yankee Bell	-17	-28	-5	5	4	-3	-19	16	3	3
Sir Galahad	-20	-33	-3	5	4	0	-16	19	9	9
Gloria	-20	-37	1	3	3	-1	-8	6	10	9
Mahi	-21	-35	-6	4	4	9	4	14	15	15
Crusader	-21	-40	2	15	13	5	-2	13	21	20
Olympus	-22	-37	-4	13	12	N/A	N/A	N/A	N/A	N/A
Red Knight	-22	-37	-5	42	32	7	1	15	11	11
King of the North	-23	-43	6	7	4	-1	-5	2	10	9
Dashen	-24	-40	-2	8	7	-4	-15	9	4	4
Bell Captain	-25	-38	-7	4	4	N/A	N/A	N/A	N/A	N/A
Procraft	-26	-45	-1	8	5	16	-8	46	5	5
Allegiance	-26	-46	0	4	3	0	-12	12	4	4
Blushing Beauty	-29	-55	11	7	7	1	-16	23	13	10
Camelot	-29	-49	-3	36	14	5	-20	35	4	4
Redstart	-30	-71	33	4	4	-31	-57	9	55	19
Seedway 48	-31	-51	-1	3	3	N/A	N/A	N/A	N/A	N/A
Peninsula	-32	-47	-14	3	3	10	1	20	9	7
Baron	-37	-76	67	5	4	9	1	17	14	13
Jupiter	-39	-67	14	11	9	8	-4	22	9	7
California	-40	-59	-12	17	12	7	-3	19	9	9
Wonder										
Early Sunsation	-44	-70	1	19	9	-10	-21	4	4	4
Admiral	-52	-78	4	5	3	N/A	N/A	N/A	N/A	N/A
Gourmet	-52	-75	-8	6	5	N/A	N/A	N/A	N/A	N/A
Delirio	-69	-93	34	4	4	N/A	N/A	N/A	N/A	N/A
Queen	-69	-76	-61	3	3	3	-16	32	6	6
ACX 209	N/A	N/A	N/A	N/A	N/A	10	-7	30	4	3
Cadice	N/A	N/A	N/A	N/A	N/A	-4	-15	9	3	3
Clovis	N/A	N/A	N/A	N/A	N/A	12	-13	50	3	3
Ma Belle	N/A	N/A	N/A	N/A	N/A	30	9	60	3	3
Marquis	N/A	N/A	N/A	N/A	N/A	1	-11	13	3	3
Outsider	N/A	N/A	N/A	N/A	N/A	4	1	8	3	3
Samurai	N/A	N/A	N/A	N/A	N/A	5	0	10	4	3
Super Sweet 860	N/A	N/A	N/A	N/A	N/A	-19	-42	13	3	3
Yellow Bell	N/A	N/A	N/A	N/A	N/A	-11	-21	3	6	4
Yolo Wonder	N/A	N/A	N/A	N/A	N/A	14	-2	32	4	3