2025
U.S. PULSE QUALITY SURVEY

Northern Pulse Growers Association

usa pulses
dry peas • lentils • chickpeas • dry beans

2025 Pulse Quality Survey

Contents

2025 Overview and Author's Comments

Summary Points

1. The 2025 pulse quality report represents the 18th iteration of a pulse quality evaluation started by the Northern Crops Institute in 2008. The data in this report includes both 5- and 10-year mean values where available. The 10-year mean represents a long-term assessment of quality.

2. Data from 315 samples received from major US pulse growing regions were evaluated. Mixed growing conditions (i.e., both dry and wet) were experienced by growers in 2025.

3. Characteristic of a Black lentil cultivar Beluga has been presented for the first time.

4. Six functionality tests and an RVA gel firmness value were reported for the fourth consecutive year.

5. Across all pulse types, protein contents in 2025 were generally comparable to or slightly lower than long-term averages, while starch contents were higher than both 5- and 10-year mean values. Fat content remained low, consistent with long-term trends.

6. Cold paste viscosity and gel firmness values for peas, lentils, and chickpeas in 2025 were generally higher than long term averages, indicating thicker pastes and firmer gels compared to previous years.

7. Canning quality results showed that hydration and swelling capacities of peas and chickpeas were similar to or higher than 5-year mean values, while canned firmness tended to be lower, indicating softer texture after processing.

This report provides a summary of the 2025 pulse crop quality for dry pea, lentil, and chickpea grown commercially in the USA. In 2025, 315 pulse samples were collected from the major US pulse growing regions. The samples evaluated included 126 dry peas, 118 lentils, and 71 chickpeas, which were acquired from pulse growers and industry representatives in pulse-growing areas in Idaho, Montana, Nebraska, North and South Dakota, and Washington.

According to USDA National Agricultural Statistics Service and the U.S.A. Pulses, pulse harvested acres in 2025 increased to 2.74 million acres, approximately 300,000 acres more than in 2024. Total U.S. pulse production was estimated at 1.78 million metric tons, higher than production in both 2024 and 2023. Dry pea acreage increased to 1.17 million acres, lentil acreage rose to 1.02 million acres, and chickpea acreage increased to 550,367 acres. Production increases across all crops reflect favorable growing conditions and expanded interest in pulses.

The quality is grouped into three main categories, which include proximate composition, physical parameters, and functional characteristics. The canning quality was also a separate category. Proximate quality parameters include ash, fat, moisture, protein, and total starch content. Water hydration capacity, percentage unhydrated seeds, swelling capacity, cooked firmness, test weight, 1000-seed weight, size distribution, and color represent the physical parameters evaluated. Functional characteristics included pasting properties and six functionality tests: emulsion activity and stability, foaming capacity and stability, water holding capacity, and oil holding capacity.

Results from the proximate (e.g., moisture, protein) composition analyses indicated that results were mixed and did not follow closely the results from any one previous year. However, some results were comparable to 5- and 10-year mean data.

In general, peas and lentils from 2025 had the same or higher moisture contents compared to pulses from previous crop years. Additionally, the moisture contents of the peas and lentils from 2025 tended to be the same or higher than the 10-year mean moisture contents of their respective pulse crop. Chickpeas had lower moisture contents compared to the 5- and 10-year values. Collectively, the data suggests that the mean long-term moisture is a good guide to predicting the moisture content of pulses. The total starch contents of pea, lentil and chickpea from 2025 were higher than their respective 5- and 10-year mean starch content. The winter pea class had total starch that was five percentage points higher than winter pea from previous production years. Green and yellow peas had starch contents that were approximately three and one percentage points, respectively, higher than their 5- and 10-year mean values. The red lentil class had a mean total starch contents in 2025 that were three percentage points higher than the 5- and 10-year mean values. The green and Spanish Brown lentil classes had mean starch contents that were five and three percentage points higher than the 5- and 10-year mean starch values. The mean protein content of peas from 2025 was comparable to the 5-year mean protein content but higher than the 10-year mean protein content. The protein content of green peas was comparable to that of the 10-year mean protein content. In contrast, the protein content in yellow peas from 2025 was comparable to that of the yellow peas from 2022 and 2024 and was higher than the 5- and 10-year mean values. Winter peas from 2025 had lower protein than winter peas from other years. Lentils from 2025 had protein content similar to lentils from 2020 and 2022. The red and green lentils had protein contents that were lower than lentils from previous years, while the Spanish brown lentils had protein contents most similar to the 10-year mean protein content. The protein content in 2025 chickpeas was lower than the 5-year mean value but was comparable to the 10-year mean protein content. Unlike 2025, the protein data from recent years supports higher protein compared to the long-term mean value. The fat contents of the pulses evaluated were within the range reported in the literature. The mean fat contents of peas, lentils, and chickpeas from 2025 were within 0.2 percentage points of their respective crops from previous years, including the 5-year mean fat content.

The mean test weight, water holding capacity, and cooked firmness of peas either matched or were lower than the 5- and 10-year mean values. The mean 1000-seed weight and swelling capacity values were higher than or matched the long-term mean values. The values of the physical parameters of lentils were the same or lower compared to their 5- or 10-year mean values. Only the 1000-seed weight of lentils was more than the 5- and 10-year mean values. In general, physical parameter values were slightly less than the 5- or 10-year mean values for chickpeas, except for swelling capacity. The large chickpea, such as Nash had 1000-seed weights of 556, 591, 526, and 530 in 2025, 2024, 2023, and 2020, respectively. This suggests that only minor differences in seed size existed for the same cultivar over different years and that the considerable number of small chickpea samples that were included in the 2025 survey likely contributed to the lower 1000-seed weight. A size distribution analysis of chickpeas indicated a slightly smaller seed size for chickpeas from 2025 compared to the 5-year mean seed size. The Nash and Dylan chickpea cultivars had the highest percentage (92.6 and 93.1%, respectively) of seeds retained on a 22/64-inch sieve in 2025. Overall, chickpea from 2025 had a lower percentage of seeds being retained on the 22/64- and 20/64-inch sieves compared to the 5-year mean value. However, the results were impacted by the Billy Bean and Kasin cultivars, as only 3 to 4% of their seeds were retained on the 22/64-inch sieve. The physical parameter values of winter peas were similar to values obtained in peas from 2021 and 2023. However, the green and yellow peas tended not to be like previous crop years except for test cook firmness and swelling capacity, which were similar to the 5- and 10-year mean values. Unlike red lentil, green and Spanish brown lentils from 2025 had similar physical parameter values as lentils used to determine the 5- and 10-year mean values for their respective color classes. The green and yellow peas in 2025 had lightness (L*) values that were greater than the 5- and 10-year mean lightness values, resulting in lighter colored seeds. The color difference values of dry peas vs. soaked peas from 2025 were comparable to peas that made up the 5- and 10-year mean color difference values. The increased yellowness was the main reason for the color differences in both the soaked green and yellow peas. The color tended to be lighter for all lentil classes in 2025. The color difference resulting from the soaking of lentils was caused mostly by an increase in the L* value. The 2025 chickpea crop had slightly lower lightness values compared to the 5-year mean L* values. Overall, the color difference between dry and soaked chickpeas was higher than the 5-year mean value but lower than the 10-year mean value.

The starch pasting properties for the 2025 peas, lentils, and chickpeas were significantly higher than the 5- and 10-mean values. The pastes that resulted from samples were more viscous than the pastes of samples from other crop years. The RVA gel firmness test indicated that peas, regardless of class, from 2025 had gel firmness values that were higher than samples from previous harvests. Regardless of market class, lentils from 2025 had significantly higher gel firmness values compared to lentils from previous years. However, the green lentils did have slightly lower hot paste viscosity compared to the 10-mean value. Chickpea followed the same pasting trends as the Spanish brown lentils but differ in that gel firmness of chickpeas was higher than chickpea from other years except 2022. Functionality tests showed that emulsion activity and stability did not differ significantly among the pulse samples from different years. The foaming capacity was lower in 2025 for pea, lentils, and chickpeas compared to previous samples. However, foam stability was either greater than or the same for all pulses from 2025 compared to pulses from 2022-2024. The oil holding capacities of all pulses were the same or higher in 2025 compared to values from pulses grown in prior years. Water holding capacity was lower in pulses from 2025 compared to pulses from previous years.

Overall, the canning quality data of peas from 2025 supports same level of rehydration of the peas and less canned firmness. The water hydration capacity of canned peas in 2025 was slightly higher than the 5-year mean values. Canning firmness was significantly lower (i.e., less firm) in 2025 compared to peas from 2021 and the 5-year mean value. Chickpeas from 2025 had hydration capacity and swelling capacity greater than canned chickpeas from other years. The mean canned firmness of chickpea from 2025 was 7.0 N/g, which is less than the 5-year mean canned firmness value.

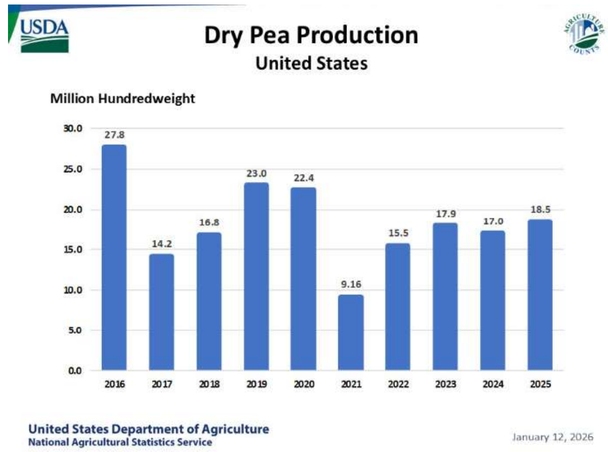
The focus of the pulse program is the quality evaluation and utilization of pulses as food and food ingredients. The mission of the Pulse Quality Program is to provide industry, academic, and government personnel with readily accessible data on pulse quality and to provide science-based evidence for the utilization of pulses as whole food and as ingredients in food products. I welcome any comments and suggestions regarding the report. If a quality trait is of interest to you, please reach out to me. I would like to thank the USA pulse producers for their support of this survey.

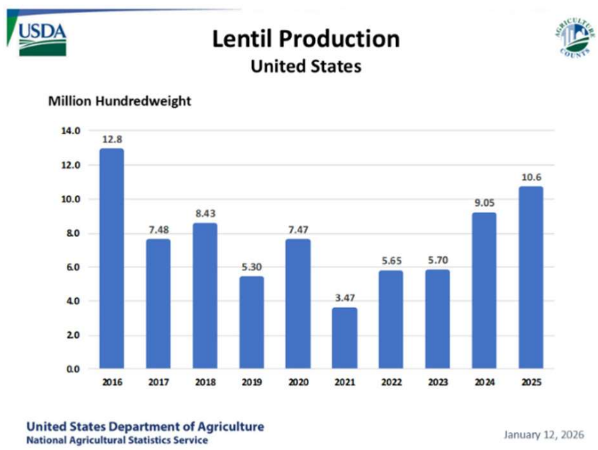
Sincerely,

Clifford Hall, Ph.D.
(clifford.hall@sdstate.edu)

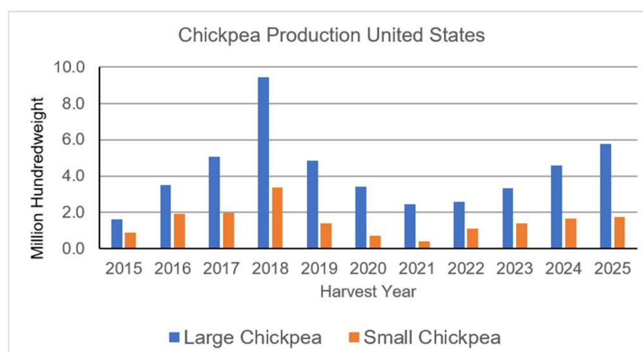
Pulse Production

The Northern Plains region and Pacific Northwest are the largest pulse producing areas within the USA. The U.S. pulse harvested acres in 2025 was 2,737,948 (Table 1), which was approximately 300,000 and 950,000 more acres than in 2024 and 2023, respectively. Total U.S. pulse production (Metric Tons (MT)) in 2025 is estimated to be 1,778,684 which is up significantly from the 1,510,553 and 1,274,291 produced in 2024 and 2023, respectively (Table 1). The favorable conditions affecting some of the pulse growing regions and higher acres planted likely contributed to the higher production compared to the previous crop years (2020-2024). The estimated dry pea acreage was 1,168,701, which was up from 988,716 and 908,527 from 2024 and 2023, respectively (Table 1). Pea production (917,772 MT) was significantly more than the 795,770 and 793,967 MT in 2024 and 2023, respectively (Table 1). The long-term production shows that the million 100-weight of peas produced in 2025 ranked fourth among peas from 2016 to 2025.





Lentil acreage was 1,018,880 in 2025. This value was significantly more than acres harvest in the previous four years (Table 1). Lentil production in 2024 was 513,097 MT, which is higher than 424,254 and 255,000 MT produced in 2024 and 2023, respectively, and is nearly 2.9 times the 2021 production of 177,571 MT. The USDA estimate of 10.6 million 100-weight of lentils exceeds production from all previous years except 2016 and is nearly two times the production compared to 2023 and 2022. Chickpea harvested acres (550,367) in 2025 was approximately 35,000 and 200,000 acres above the 2024 and 2023 acres of 514,110 and 356,800, respectively. Production was estimated at 347,514 MT, which is significantly higher than the production from previous years (Table 1). Furthermore, the production of large chickpeas more than tripled the production of small chickpeas. The higher production of pulses supports the producer's ability to meet the demand for U.S. pulses.



The yield for dry pea was 1738 lbs./acre in 2025, which is down from 1775 and 1924 lbs./acre in 2024 and 2023, respectively, but comparable to the 1747 lbs./acre in 2022. Lentil yield (1112 lbs./acre) was higher than the 1002 and 1089 lbs./acre observed in 2024 and 2023, respectively. The consistent yields in recent years are likely to be the combination of genetics and growing environment. Chickpea yield (1,315 lbs./acre) was approximately the same as in 2023 (1,306 lbs./acre), and higher than the 1,144 and 1079 lbs./acre for the chickpea crop in 2024 and 2022, respectively. For additional in-depth production data, please visit https://www.usapulses.org/.

Table 1. United States pulses acreage and production summary for 2021-2025.

	2025		2024		2023		2022		2021	
Crop	Acreage*	Production#	Acreage*	Production#	Acreage	Production	Acreage	Production	Acreage	Production
Dry Peas	1,168,701	917,772	988,716	795,770	908,527	793,967	872,544	673,248	942,794	425,466
Lentil	1,018,880	513,097	939,662	424,254	523,000	255,000	620,185	256,259	661,803	177,571
Chickpea	550,367	347,815	514,110	290,529	356,800	225,324	341,700	177,502	251,000	130,487
Total	2,737,948	1,778,684	2,442,488	1,510,553	1,788,327	1,274,291	1,834,429	1,107,009	1,855,597	733,524

*Acreage = Acres Harvested, #Production = Metric Tons, Source: USDA NASS (2026)/ USA Pulses

Laboratory Methods Used to Measure Pulse Quality

Where applicable, standard methods were followed for the determination of each pulse quality attribute in 2025 (Table 2). For most analyses, data is provided on data collected between 2021 and 2025. The data is reported as a range, mean, and standard deviation (SD) for the 2025 harvest year, while preceding years were provided as a mean plus SD. Data on cultivars was reported only for the 2025 harvest years, and no comparisons were made in the tables to cultivars from the previous year. A summary of the testing methods can be found in Table 2. Further information on the testing methods is provided below.

- Moisture content is the quantity of water (i.e., moisture) present in a sample and is expressed as a percentage. Moisture content is an important indicator of pulse seed handling and storability. Pulse crops are recommended for harvest at 13-14% moisture. At lower moisture levels, the seeds are prone to mechanical damage such as fracturing. Pulses with higher moisture levels are more susceptible to enzymatic activity and microbial growth, which reduces quality and increases food safety risks.
- Pulses are rich in protein, which ranges from 20 to 30% depending on the growing location, cultivar, and year. Pulses are low in sulfur-containing amino acids but high in lysine, an essential amino acid for human health. Protein content is the quantity of protein present in a sample and is expressed as a percentage.
- The fat (i.e., lipid) content is the quantity of fat present in the pulse. Usually, peas and lentils have fat contents under 3% while chickpeas contain 5-8%.
- Ash content is the quantity of ash present in a sample and is expressed as a percentage. Ash is an indicator of minerals. Higher ash content indicates higher amounts of minerals such as iron, zinc, and selenium.
- Total starch is a measure of the quantity of starch present in a sample and is expressed as a percentage. Starch is responsible for a significant part of the pulse functionality, such as gel formation and viscosity enhancement. Enzymatic hydrolysis is the basis for starch determination. Starch functionality is measured using the RVA instrument. Pulses show a type C pasting profile, which is represented by a minimally definable pasting peak, a small breakdown in viscosity, and high final peak viscosity. This type of starch is ideal for glass noodle production.
- Test weight and 1000-seed weight are indicators of seed density, size, shape, and milling yield. Each pulse crop has its own market preference based on color, seed size, and shape. A grain analysis computer is used to determine test weight in lbs./bu.
- Water hydration capacity, percentage unhydrated seeds, and swelling capacity are physical characteristics of pulses that relate to the ability of the pulse to rehydrate. The swelling capacity relates to the increased size of the pulse as the result of rehydration. Cooking firmness provides information on the texture (i.e., firmness) of the pulse after a cooking process. The data obtained can be used to predict how a pulse might change during cooking and canning processes.
- Color analysis is provided as L*, a* and b* values. Color analysis is important as it provides information about the general pulse color and color stability during processing. Color difference is used specifically to indicate how a process affects color. In this report, the color difference between pre- and post-soaked pulses was determined.
    - "L*" represents the lightness on a scale where 100 is considered a perfect white and 0 is for black. Pulses such as chickpeas and yellow peas typically have higher L* values than green or red pulses. The "a*" value represents positive for redness and negative for green, and "b*" represents positive for yellow, negative for blue, and zero for gray. A pulse with a higher positive "b*" value would be indicative of a yellow pulse, while a higher "a*" value represents a pulse with a red-like hue; thus, brown pulses have a higher red value than a yellow pulse. Green pulses have negative "a*" values, and thus, the greater the negative value, the greener the pulse.
- Canning quality evaluation. This evaluation serves as an Indicator of pulse quality after a canning process and a three-week storage. The information allows for a relative difference in quality to be established following a canning process that used a brine solution containing calcium chloride.
- The functionality test includes emulsion activity and stability, foaming capacity and stability, water holding capacity, and oil holding capacity.
    - Emulsions are a heterogeneous combination or dispersion of two or more immiscible liquids, usually oil and water, which are formed with the aid of mechanical agitation. Stability of an emulsion is simply a gravitational separation of the two primary phases of a mixture.
    - Foams are a dispersion of gas bubbles in a liquid or solid phase. Foaming capacity is the amount of interfacial area that can be created by whipping the flour. Foam stability is defined as the time needed to lose 50% of either the liquid or the volume of foam. These properties can be important for products such as cakes.
    - Water holding capacity and oil holding capacity are measures that allow for the determination of the amount of water or oil that can bind to the flour. This information is important because it allows product developers to identify how much water or oil may be taken up by flour and thus allows them to adjust formulations as needed.

Table 2. Quality attribute, analytical method, and remarks for analyses conducted for the 2024 pulse quality survey.

Quality Attribute	Method	Remarks
1. Moisture (%)	AACC Approved Method of Analysis, Method 44-15.02	An indicator of post-harvest stability, milling yield, and general processing requirements.
2. Protein (%)	AACC Approved Method of Analysis, Method 46-30.01	An indicator of nutritional quality and the amount of protein available for recovery.
3. Ash (%)	AACC Approved Method of Analysis, Methods 08-01.01	An indicator of total non-specific mineral content.
4. Total starch (%)	AACC Approved Method of Analysis, Method 76-13.01	An indicator of nutritional quality and the amount of starch available for recovery.
5. Fat (Lipid)	AOCS Method Ba 3-38	An indicator of nutritional quality as related to the amount of fat in the samples.
6. Test weight (lbs./bu)	AACC Approved Method of Analysis, Method 55-10.01	An indicator of sample density, size, and shape.
7. 1000-seed weight (g)	100-kernel sample weight times 10	Indicator of grain size and milling yield.
8. Chickpea Size Determination	Four samples of 250 seeds of chickpea were placed on a series of sieves (22/64", 20/64", 18/64") and rotated. The number of seeds retained on each sieve was determined and reported as % of seeds retained.	Indication of the size distribution within a sample of chickpea.
9. Water hydration capacity (%)	AACC Approved Method of Analysis, Method 57-12.02	An indicator of cooking and canning behavior.
10. Unhydrated seed (%)	AACC Approved Method of Analysis, Method 57-12.02	An indicator of cooking and canning behavior and the number of seeds that may not rehydrate.
11. Swelling Capacity (%)	Determined by measuring the volume before hydration (i.e., soaking) and after. The percentage increase was then determined.	An indicator of the amount of volume regained by a pulse after being rehydrated.
12. Color	Konica Minolta CR-410 Chroma meter. The L*, a*, and b* values were recorded.	An indicator of visual quality and the effect of processing on color.
13. Color Difference ($\Delta E^{*}ab$)	The color difference between the dried (pre-soaked) and the soaked pulse was determined using L*, a*, and b* values from the color analysis as follows (*Minolta*): $\Delta E^{*}ab = [(\Delta L^{*})^2 + (\Delta a^{*})^2 + (\Delta b^{*})^2]^{1/2}$	An indicator of the general color difference between pre- and post-soaked pulses. The lower the value, the more stable the color.
14. Starch Properties (RVU)	Rapid Visco Analyzer following a modified AACC Approved Method 61-02.01. Modification included a different heating profile and longer running time. Gel firmness was completed 2 hours after the RVA. The sample was compressed at a speed of 4 mm/s to a distance of 15 mm and trigger force of 2 g with a cylindrical plunger (diameter=10 mm)	An indicator of texture, firmness, and gelatinization properties of the starch.
15. Cook Firmness	AACC Approved Method of Analysis, Method 57-14.02	An indicator of pulse firmness after the cooking process. The information allows for a relative difference in texture to be established.
16. Emulsion Properties	Maskus, et al. (2016). Cereal Foods World. 61(2): 59-64.	An indicator of the ability of the flour to facilitate the formation of an emulsion from oil and water when subjected to shear.
17. Foaming Properties	Stone, et al. (2015). Food Research International 76:31-38.	An indicator of the ability of the flour to foam when flour or protein is made into a solution and subjected to shear.
18. Water Holding Capacity	AACC Approved Method of Analysis, Method 57-13.02.	An indicator of the weight of water that will bind to one gram of flour. An important parameter for producing meat and bakery products.
19. Oil Holding Capacity	Method of Wang et al. (2020). Cereal Chemistry 97:1111-1117.	An indicator of the weight of oil that will bind to one gram of flour. An important parameter for producing meat and salad dressing products.
20. Canning Quality	Followed methods associated with quality attributes 9, 11, 13, and 15. Canning was completed in laminated metal cans using calcium chloride brine, with processing times of 20 minutes and 20 psi for pea and 70 minutes at 20 psi for chickpea.	Indicator of pulse quality after a canning process and 3-week storage. The information allows for a relative difference in quality to be established following a canning process that used a brine solution containing calcium chloride.

Dry Pea Quality Results

Sample distribution

A total of 126 dry pea samples were collected from Idaho, Montana, Nebraska, North Dakota, South Dakota, and Washington from August 2025 to November 2025. Samples were delivered to SDSU between November 2025 and February 2026. The growing location, number of samples, market class, and genotype details of these dry pea samples are provided in Table 3. Most of the pea samples were obtained from Montana. Green peas accounted for 61 of the samples collected, whereas Arcadia accounted for ten of the green pea samples and Passion accounted for four samples.

Table 3. Description of dry pea samples used in the 2025 pulse quality survey.

State	No. of Samples	Market Class	Cultivars	
Idaho	3	Green	Banner	Passion
			Ultra	
Montana	104	Green	Arcadia	Hampton
			PG Greenback	
		Mottled	Unknown Maple	
		Yellow	AAC IronHorse	CDC Meadow
			Treasure	
Nebraska	5	Yellow	AAC Chrome	AAC IronHorse
			AAC Julius	
		Winter	Winterberry	
North Dakota	2	Yellow	AAC Julius	Iconic
South Dakota	4	Yellow	CDC Inca	
Washington	8	Green	Ariel	Banner
			Passion	
		Winter	Blaze (Yellow)	Vail (Green)

Yellow peas accounted for 60 of the pea samples collected. The samples collected were a mix of cultivars listed in Table 3, but AAC IronHorse, AAC Julius, and AACC Chrome accounted for most of the identified cultivars. Four winter peas were evaluated in 2025. The Blaze and Vail cultivars accounted for three of the samples evaluated. For the first time, the Winterberry cultivar was included in the survey.

Proximate composition of dry pea (Tables 4-6)

Moisture

The moisture content of dry pea ranged from 7.7-12.6% in 2025 (Table 4). The mean moisture content of all pea samples was 10.1%, which is slightly higher than the 5-year mean of 9.6% but the same as the 10-year mean of 10.1%. The moisture content is lower than the 14% recommended for general storability; however, long term storage under dry conditions could reduce seed moisture to lower levels where damage during storage and handling could occur. In 2025, no samples had moisture contents greater than 13%, likely due to drier conditions during harvest. Most pea samples had moisture contents between 9.1% and 11%. The mean moisture contents between the three market/color classes varied by 2 percentage points. Mean moisture ranged from 8.2 % in winter peas to 10.2% for the green peas (Table 5). The green pea moisture percentage of 10.2% was slightly higher than both the 5- and 10-year mean moisture contents of 9.4 and 9.7%, respectively. The yellow pea mean moisture percentage was 10.1%, which was less than the 10-year mean values of 10.4%, but slightly higher than the 5-year mean value of 9.9% (Table 5). Overall, the mean moisture contents of the green peas from 2025 were not like most moisture contents in peas between 2021 and 2024. In contrast, moisture content in yellow peas from 2025 were like moisture contents in peas from 2024. Winter peas had lower moisture percentages in 2025 compared to winter peas from most years except the values for winter peas from 2021. The highest moisture contents were observed in the AAC Julius and CDC Inca (yellow pea) cultivars (Table 6). The winter cultivars Vail and Blaze had the lowest moisture contents of 7.9% while Winterberry had a moisture of 9.1%. Mottled pea had moisture content of 9.6% (Table 6).

Table 4. Proximate composition of dry pea grown in the USA, 2021-2025 and the 5- and 10-year means.

Proximate Composition (%)*	Year							
	2025		2024	2023	2022	2021	5-year	10-year
	Range	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Moisture	7.7-12.6	10.1 (0.9)	9.9 (1.3)	9.4 (1.2)	9.3 (1.1)	9.7 (1.3)	9.6 (0.2)	10.1 (0.9)
Ash	2.0-3.1	2.3 (0.2)	2.5 (0.3)	2.3 (0.3)	2.8 (0.1)	2.6 (0.2)	2.5 (0.1)	2.5 (0.2)
Fat	0.7-2.1	1.2 (0.2)	1.0 (0.3)	1.0 (0.2)	1.2 (0.2)	1.0 (0.2)	1.2 (0.3)	**
Protein	16.1-26.8	22.6 (1.8)	23.0 (1.9)	22.9 (2.2)	23.4 (1.5)	23.1 (1.1)	22.8 (0.8)	21.9 (1.1)
Total Starch	39.2-51.0	44.5 (2.1)	42.8 (3.5)	40.9 (2.0)	42.6 (3.2)	42.9 (1.9)	42.7 (1.3)	42.7 (0.9)

*composition is on an "as is" basis; **not previously reported prior to 2017

Table 5. Proximate composition of different classes of dry pea grown in the USA, 2021-2025; 5- and 10-year means.

Proximate Composition (%)*	Mean (SD) of green pea 2025	2024	2023	2022	2021	5-year Mean (SD)	10-year Mean (SD)
Moisture	10.2 (1.0)	9.6 (1.3)	9.4 (1.5)	9.4 (0.9)	9.2 (1.3)	9.4 (0.2)	9.7 (0.7)
Ash	2.3 (0.1)	2.4 (0.2)	2.8 (0.2)	2.6 (0.2)	2.6 (0.3)	2.6 (0.2)	2.5 (0.1)
Fat	1.2 (0.2)	1.0 (0.2)	1.2 (0.2)	1.0 (0.2)	1.6 (0.6)	1.2 (0.3)	nd
Protein	22.7 (1.6)	23.9 (2.3)	23.2 (2.1)	23.3 (1.0)	23.5 (1.3)	23.6 (0.3)	22.5 (1.2)
Total Starch	44.5 (2.0)	39.9 (2.0)	43.1 (2.2)	42.7 (1.4)	45.1 (3.0)	42.1 (2.2)	42.1 (1.6)
Proximate Composition (%)*	**Mean (SD) of yellow pea 2025**	**2024**	**2023**	**2022**	**2021**	**5-year Mean (SD)**	**10-year Mean (SD)**
Moisture	10.1 (0.8)	10.2 (1.4)	9.5 (1.0)	9.3 (1.4)	10.8 (0.6)	9.9 (0.6)	10.4 (1.0)
Ash	2.3 (0.2)	2.5 (0.3)	2.3 (0.1)	2.8 (0.1)	2.5 (0.1)	2.5 (0.2)	2.5 (0.1)
Fat	1.2 (0.2)	1.0 (0.3)	1.1 (0.2)	1.2 (0.1)	1.1 (0.1)	1.2 (0.3)	nd
Protein	22.6 (1.9)	22.7 (1.9)	21.7 (1.4)	22.6 (0.9)	23.0 (1.0)	22.3 (0.7)	21.5 (1.0)
Total Starch	44.3 (2.0)	43.3 (3.1)	41.8 (1.7)	45.6 (1.1)	43.5 (2.5)	43.6 (1.4)	43.1 (1.2)
Proximate Composition (%)*	**Mean (SD) of winter pea 2025**	**2024**	**2023**	**2022**	**2021**	**5-year Mean (SD)**	**10-year Mean (SD)**
Moisture	8.2 (0.6)	8.5 (1.4)	8.6 (0.4)	9.2 (0.5)	8.4 (0.9)	9.1 (0.6)	nd
Ash	2.3 (0.2)	2.6 (0.4)	2.8 (0.2)	2.9 (0.1)	2.7 (0.2)	2.7 (0.2)	nd
Fat	1.3 (0.6)	0.8 (0.4)	1.0 (0.2)	1.1 (0.1)	0.8 (0.1)	1.1 (0.4)	nd
Protein	22.6 (3.6)	23.6 (1.1)	23.4 (2.6)	24.1 (1.2)	23.1 (1.5)	23.1 (1.0)	nd
Total Starch	47.3 (3.6)	40.6 (1.7)	41.9 (1.8)	40.0 (2.8)	43.5 (1.3)	42.0 (1.7)	nd

*composition is on an "as is" basis; nd = not determined due to test not being performed for 10 years on samples.

Ash

The ash content of dry peas ranged from 2.0 to 3.1%, with a mean of 2.3%. The mean ash content (2.3%) of dry peas grown in 2025 was slightly lower than the 2.5% value for the 5- and 10-year mean ash contents (Table 4). Ash content is a general indicator of minerals present and has been consistent over the ten-year evaluation of peas. The mean ash contents of green, yellow and winter peas classes were all 2.3% (Table 5). The green and yellow pea ash contents were essentially the same as their respective 5- and 10-year mean ash values of approximately 2.5%. Winter peas had a slightly lower mean ash content (2.3%) than the 5-year mean ash content of 2.7 (Table 5). The ash percentage in individual samples ranged from 2.0% in Ariel and Ultra to 2.6% in green peas (Table 6). Ariel also had the lowest ash content in samples from 2024. For yellow peas, AAC Chrome (2.2%) and AAC IronHorse and Treasure had the lowest and highest ash contents, respectively. Vail and Winterberry winter peas had similar ash contents, while the ash content of mottled peas was 2.6% (Table 6). Although small variations were observed in ash content, overall, the ash contents were consistent.

Table 6. Mean proximate composition of dry pea cultivars grown in the USA in 2025.

Market Class	Cultivar	Concentration (%)* Moisture	Ash	Fat	Protein	Starch
Green	Arcadia	10.2	2.3	1.2	22.8	43.2
	Ariel**	9.4	2.0	1.3	22.9	44.9
	Banner	9.0	2.2	1.5	22.1	46.8
	Hampton**	9.8	2.6	1.1	25.3	43.3
	Passion	8.5	2.3	1.2	21.3	46.0
	PG Greenback	10.4	2.2	1.4	22.0	44.7
	Ultra**	8.4	2.0	1.8	20.1	43.1
Yellow	AAC Chrome**	9.0	2.2	1.2	22.0	46.8
	AAC IronHorse	8.9	2.5	1.2	21.8	46.6
	AAC Julius	10.5	2.4	1.3	22.8	47.0
	CDC Inca	10.5	2.4	1.2	23.6	42.0
	CDC Meadow	9.6	2.4	0.9	22.9	44.0
	Iconic**	10.4	2.3	1.3	22.4	48.0
	Treasure	9.5	2.5	0.9	22.9	44.5
Winter Green	Vail**	7.9	2.4	0.7	26.0	48.7
Winter Yellow	Blaze	7.9	2.2	1.6	19.5	49.3
	Winterberry**	9.1	2.5	1.2	25.4	41.9
Mottled/Maple	n/p**	9.6	2.6	1.0	20.8	44.0

*composition is on an "as is" basis; **Only one sample of cultivar tested;n/p = not provided

Fat (Lipid)

The fat content of dry peas ranged from 0.7 to 2.1%, with a mean of 1.2% (Table 4). The mean fat content (1.2%) of peas harvested in 2025 was higher than the fat content of peas harvested between 2021 and 2024 except peas from 2022. In addition, the fat content (1.2%) was same as the 5-year mean fat content (Table 4). The fat contents of the green and yellow classes were only 0.1 percentage points lower than the fat contents in winter peas (Table 5). Overall, the mean fat contents in the green and yellow peas were the same as their 5- and 10-year mean values (1.2%). The mean fat content (1.3%) of winter peas was slightly higher than the 5-year mean value (1.1%). The Ultra cultivar had the highest fat content (1.8%) among green pea cultivars, while AAC Julius and Iconic had the highest fat content of the yellow peas (Table 6). Regardless of color, most other cultivars had fat contents around 1.0-1.2% (Table 6). The fat content of winter pea samples ranged from 0.7% in Vail to 1.6% in Blaze while Mottled pea has a fat content of 1.0%. Regardless of the sample, all peas had a very low-fat content.

Protein

Protein content of dry peas harvested in 2025 ranged from 16.1 to 26.8% with a mean of 22.6% (Table 4). The mean protein content of peas from 2025 was comparable to the value for peas from 2023. Furthermore, the mean protein (22.6%) was lower than the 5-year mean protein contents of 22.8 and higher than the 10-year mean value of 21.9% (Table 4). The mean protein contents of the green, yellow, and winter pea samples were 23.3, 22.7, and 23.6%, respectively (Table 5). Green pea samples had a mean protein content (22.7%) that was lower than the 5-year mean value of 23.6 but slightly higher than the 10-year mean (22.5%). Yellow peas had a mean protein content (22.6%) that was higher than the 5- and 10-year mean protein contents of 22.3 and 21.5%, respectively (Table 5). The mean protein content of Winter peas was 22.6%, which was lower than the 5-year mean value of 23.1%. The data supports slightly higher protein contents in recent years compared to long-term mean values. The Hampton cultivar had the highest mean protein content (25.3%) while Ultra cultivar had the lowest (20.1%) among green peas (Table 6). CDC Meadow and Treasure cultivars had the highest (22.9%) protein content among yellow peas while AAC IronHorse had the lowest (21.8%) protein contents of the yellow peas (Table 6). In winter peas, Vail and Winterberry had similar protein contents, while the Blaze had the lowest (19.5%) mean protein content of the winter pea. Mottled pea sample had a protein content of 20.8% (Table 6).

Total starch

Total starch content of dry pea ranged from 39.2 to 51.0% with a mean of 44.5% (Table 4). The mean total starch content of dry peas grown in 2025 was higher than the total starch in dry peas from the 2021 and 2024 harvest years and the 5- and 10-year mean total starch values of 42.7%. The starch contents of the green and yellow classes were 44.5 and 44.3%, respectively (Table 5). Green peas had a mean starch content (44.5%) that was higher than the 5-year and 10-year mean values of 42.1%. Only peas from 2021 had a mean starch content that was higher than peas from 2025. The 5- and 10-year mean starch contents for the yellow peas were 43.6 and 43.1%, respectively. These values were lower than the mean starch content (44.3%) of yellow peas harvested in 2025. Winter peas from 2025 had a mean starch content (47.3%) that was significantly higher than winter peas from previous harvest years (Table 5). Furthermore, the mean starch content of winter peas from 2025 was significantly higher than the 5-year mean value of 42.0%.

Among green peas, Banner and Ultra had the highest (46.8%) and lowest (43.1%) mean total starch contents, respectively (Table 6). CDC Inca and Iconic had the lowest (42.0%) and highest (48.0%) mean total starch contents among yellow peas. Winterberry and Blaze had the lowest (41.9%) and highest (49.3%) mean total starch contents among winter pea samples (Table 6). The Blaze cultivar also had the highest (41.1, 43.4 and 49.6%) total starch in 2024, 2023, and 2021, respectively, and suggests that cultivar may impact the starch content (Table 6).

The general trend for all samples supports similar protein, higher starch, and lower fat contents in samples grown in 2025 compared to previous years. The higher starch contents may have been impacted more by varieties evaluated than by environmental conditions. Warmer temperatures tend not to promote starch fill in the seeds; thus the expected low starch content was not realized in 2025 and thus cultivar likely contributed more to the composition than growing environment.

Physical parameters of dry pea (Tables 7-11)

Test weight ranged from approximately 57.9 to 63.9 lbs./Bu with a mean of 61.1 lbs./Bu. This mean value was lower than the 5- and 10-year mean values of 62.9 and 63.3 lbs./Bu, respectively (Table 7). The mean test weight for all pea samples harvested in 2025 was slightly lower than that of those harvested in previous years except 2022. The test weights of peas in the green and yellow classes were 61.3 and 60.8 lbs./Bu, respectively (Table 8). The mean value for green and yellow peas was lower than the 5- and 10-year mean test weights. Winter peas had a mean test weight of 62.3 lbs./Bu, which was comparable to the winter peas from 2022 – 2024 but lower than the 5-year mean value and the test weight of samples from 2021 (Table 8). The test weight of individual cultivars varied within their respective green and yellow classes, with few exceptions (Table 9). Passion (green) and AAC IronHorse and CDC Inca (yellow) had the highest test weights in their respective classes. The lowest test weights were 60.0 and 58.8 lbs./Bu for the Hampton (green) and CDC Meadow (yellow) varieties, respectively (Table 9). Among the winter peas, the Blaze cultivar had slightly higher test weight than Vail, both of which were more than the test weights of the Winterberry cultivar (Table 9).

Table 7. Physical parameters of dry pea grown in the USA, 2021-2025 plus the 5- and 10-year means.

Physical Parameter	Year							
	2025		2024	2023	2022	2021	5-year	10-year
	Range	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Test Weight (lb/bu)	57.9-63.9	61.1 (1.3)	63.1 (1.4)	63.7 (1.2)	59.5 (5.9)	64.7 (1.3)	62.9 (2.0)	63.3 (1.4)
1000 Seed Wt (g)	127-292	203 (30)	190 (28)	194 (34)	182 (41)	199 (40)	200 (20)	208 (17)
Water Hydration Capacity (%)	84-116	97 (6)	115 (13)	102 (9)	112 (6)	100 (6)	105 (8)	104 (7)
Unhydrated Seeds (%)	0-3	1 (1)	0 (1)	2 (3)	1 (4)	0 (1)	1 (1)	1 (1)
Swelling Capacity (%)	112-187	138 (10)	144 (21.4)	133 (14)	141 (19	146 (12)	136 (11)	141 (10)
Cooked Firmness (N/g)	6.4-39.4	21.3 (6.4)	22.0 (5.5)	22.6 (6.2)	22.1 (7.3)	24.0 (5.2)	23.1 (1.3)	22.6 (1.4)

Table 8. Physical parameters of different classes of dry pea grown in the USA, 2021-2025 plus the 5- and 10-year means.

Physical Parameter	Mean (SD) of green pea					5-year	10-year
	2025	2024	2023	2022	2021	Mean (SD)	Mean (SD)
Test Weight (lb/bu)	61.3 (1.1)	63.0 (1.6)	63.1 (1.0)	59.3 (5.9)	64.4 (1.9)	62.8 (2.0)	62.9 (1.4)
1000 Seed Wt (g)	206 (31)	180 (16)	193 (29)	182 (45)	193 (26)	194 (16)	196 (13)
Water Hydration Capacity (%)	96 (5)	118 (12)	102 (12)	111 (8)	105 (3)	107 (8)	107 (6)
Unhydrated Seeds (%)	0 (0)	0 (0)	3 (4)	3 (6)	0 (0)	2 (1)	1 (1)
Swelling Capacity (%)	136 (7)	144 (25)	133 (12)	137 (31)	149 (12)	137 (11)	141 (9)
Cooked Firmness (N/g)	22.4 (6)	20.2 (4.2)	23.0 (4.5)	24.2 (5.8)	21.4 (5.5)	22.1 (1.5)	21.3 (2.1)
Physical Parameter	**Mean (SD) of yellow pea**					**5-year**	**10-year**
	2025	**2024**	**2023**	**2022**	**2021**	**Mean (SD)**	**Mean (SD)**
Test Weight (lb/bu)	60.8 (1)	63.2 (1.3)	64.6 (1.1)	54.2 (5.9)	63 (2)	61.9 (4.4)	62.8 (3.1)
1000 Seed Wt (g)	204 (28)	198 (30)	207 (36)	221 (30)	244 (28)	221 (19)	221 (13)
Water Hydration Capacity (%)	97 (6)	114 (14)	98 (5)	108 (5)	93 (7)	102 (9)	102 (7)
Unhydrated Seeds (%)	0 (1)	0 (0)	3 (2)	0 (0)	2 (3)	1 (1)	1 (1)
Swelling Capacity (%)	139 (11)	144 (21)	131 (14)	143 (20)	116 (12)	134 (11)	140 (10)
Cooked Firmness (N/g)	20.3 (5)	23.1 (5.4)	24.5 (6.5)	28.3 (7.1)	27.2 (6.6)	25.8 (2.1)	24.2 (2.4)
Physical Parameter	**Mean (SD) of winter pea**					**5-year**	**10-year**
	2025	**2024**	**2023**	**2022**	**2021**	**Mean (SD)**	**Mean (SD)**
Test Weight (lb/bu)	62.3 (2)	62.7 (0.5)	63.2 (1.1)	63.6 (0.9)	65.0 (0.7)	63.9 (1.1)	nd
1000 Seed Wt (g)	157 (26)	162 (15)	161 (24)	152 (12)	156 (14)	161 (9)	nd
Water Hydration Capacity (%)	106 (7)	114 (9)	110 (3)	115 (2)	103 (5)	108 (8)	nd
Unhydrated Seeds (%)	0 (0)	0 (1)	0 (1)	1 (1)	0 (0)	1 (1)	nd
Swelling Capacity (%)	154 (22)	154 (8)	141 (24)	141 (6)	156 (7)	142 (15)	nd
Cooked Firmness (N/g)	17.2 (5)	17.4 (7.0)	16.1 (6.7)	16.0 (2.1)	24.3 (3.7)	19.1 (3.7)	nd

nd = not determined due to test not being performed for 10 years.

Table 9. Mean physical parameters of USA dry pea cultivars grown in 2025.

Market Class	Cultivar	Test Weight (lb/bu)	1000 Seed Weight (g)	Water Hydration Capacity (%)	Unhydrated Seeds (%)	Swelling Capacity (%)	Cooked Firmness (N/g)
Green	Arcadia	61.2	190	98	0	136	23.2
	Ariel*	60.2	186	98	0	130	16.1
	Banner	60.2	177	101	0	145	21.6
	Hampton*	60.0	157	102	0	137	6.7
	Passion	60.6	200	100	0	133	19.8
	PG Greenback	61.4	230	97	0	137	22.5
	Ultra*	61.0	189	107	0	157	15.0
Yellow	AAC Chrome*	60.8	233	93	0	126	24.2
	AAC IronHorse	61.2	197	95	0	131	18.9
	AAC Julius	59.5	212	91	0	133	19.2
	CDC Inca	61.2	211	93	0	130	30.5
	CDC Meadow	58.8	204	95	0	125	14.7
	Iconic*	60.1	292	93	0	156	17.9
	Treasure	60.7	214	101	0	133	16.0
Winter Green	Vail*	63.1	127	116	0	147	10.1
Winter Yellow	Blaze	63.3	177	102	0	165	18.0
	Winterberry*	59.4	147	103	0	146	22.7
Mottled/Maple	n/p*	63.4	166	99.0	1	139	26.5

*Only one sample of cultivar tested; n/p = not provided

The range and mean **1000-seed weight** of dry peas grown in 2025 were 127-292 g and 203 g, respectively (Table 7). The mean value (203 g) was slightly lower than the 10-year mean 1000-seed weight of peas but slightly higher than the 5-year mean. This supports slightly lighter seeds for the peas harvested in 2025 compared to long-term averages. The green peas had a mean 1000-seed weight of 206 g, which is higher than the 5- and 10-year mean value 1000-seed weights of 194 and 196 g, respectively (Table 8). Green peas from 2025 had 1000- seed weights that were significantly higher than green peas from the most recent harvests. In contrast, yellow peas had a mean 1000-seed weight of 204 g, which is higher than the 1000-seed weight of yellow peas from 2024 but lower than the 5- and 10-year mean 1000-seed weight (Table 8). Winter pea samples harvested in 2025 had a lower mean 1000-seed weight compared to peas harvested in previous years, except peas from 2021 and 2022.

The individual cultivars (Table 9) varied extensively in 1000-seed weight, where the Hampton and PG Greenback cultivars in the green peas had the lowest (157 g) and highest (230 g) mean 1000-seed weights, respectively. AAC IronHorse (197 g) and Iconic (292 g) had the lowest and highest 1000-seed weight of the yellow peas, respectively (Table 9). The Vail and Blaze winter peas had the lowest (127 g) and highest (177 g) 1000-seed weight, respectively. The mottled pea had a 1000-seed weight (166 g) most similar to the winter peas (Table 9).

The water absorption or hydration properties of peas are important for understanding how peas will hydrate and increase in size and weight. These properties are important for pulse cooking and canning.

Water hydration capacity of dry peas ranged from 84 to 116%, with a mean of 97% (Table 7). In 2025, the mean water hydration capacity was lower than the value from previous years, including the 5- and 10-year mean values of 105 and 104%, respectively. Unlike 2024, the mean water hydration capacity of green peas was lower than the mean hydration capacity of both the yellow and winter peas (Table 8). The mean water hydration capacity of the green peas in 2025 was lower than the 5- and 10-year mean values of 107%. The yellow peas from 2025 had a mean water hydration capacity that was higher than peas from 2021 and comparable to the peas from 2023. However, 2025 mean water hydration capacity was slightly lower than the 5- and 10-year mean water hydration capacities.

The mean hydration capacity (106%) for the winter peas was also comparable to the 5-year mean value (108%). However, the mean hydration capacity of winter peas was lower than peas from 2022 – 2025. PG Greenback and Ultra had the lowest (97%) and highest (107%) water hydration capacities among green peas, respectively. The water hydration capacity ranged from 91% in AAC Julius to 101% in the Treasure cultivar of yellow peas (Table 9). Treasure also had the highest water hydration capacity in 2024. Blaze and Vail cultivars had the lowest (102%) and highest (116%) water hydration capacity in the winter peas. The water hydration capacity for mottled peas was 99%.

Unhydrated seed percentage ranged from 0-3% with a mean of 1%, which is same as the 5- and 10-year mean unhydrated seed percentage (Table 7). Green and yellow peas had unhydrated seed values of 0% (Table 8). Winter peas also had a 0% unhydrated seed rate. All pea samples had lower unhydrated seed percentages than the 5- and 10-year mean values (Table 8). In addition, all individual green, yellow and winter pea cultivars had unhydrated seed rates of 0% (Table 9). The mottled pea tested had unhydrated seed percentages of 1%. The low unhydrated seed rates suggest that no issues should occur during rehydration of the peas.

The **swelling capacity** is the amount of swelling that occurs during rehydration of the dry pea. This is important for packaged pulse products that are hydrated and cooked in a package. The swelling capacity of all peas ranged from 112% to 187%, with a mean value of 138% (Table 7). The mean swelling capacity for peas from the 2025 harvest was comparable to the 5- and 10-year mean swelling capacities (Table 7). The mean swelling capacity was higher than values from samples from 2023 harvest year. The swelling capacity of green peas from 2025 was comparable to the mean swelling capacity of yellow peas (Table 8). However, the green and yellow peas had significantly lower swelling capacities than winter peas.

The green peas had swelling capacities that were lower than their respective 5- and 10-year mean swelling capacities (Table 9). Swelling capacities of green peas from 2025 matched those of peas from 2022.

The yellow peas had swelling capacities that were higher than the 5- and 10-year mean swelling capacities (Table 8). The 2025 winter peas also had higher mean swelling capacity than the 5-year mean value. Variability in the swelling capacity among cultivars was observed (Table 9). Ariel and Ultra had the lowest (130%) and highest (157%) swelling capacity of the green peas. CDC Meadow and Iconic had the lowest (125%) and highest (156%) swelling capacities among the cultivars evaluated (Table 9). The swelling capacity among winter peas ranged from 146% (Winterberry) to 165% (Blaze).

The **cooked firmness** values for all peas combined were slightly lower in the peas from 2025 compared to the 5- and 10-year mean cooked firmness values. The cooked firmness for all peas ranged from 6.4 to 39.4 N/g with a mean value of 21.3 N/g (Table 7). The cooked firmness of peas was different between pea classes (Table 8). The winter peas had lower mean firmness values than those of the green and yellow peas. The mean cooked firmness of green peas obtained in 2025 was comparable to the 5-year mean value but higher than the 10-year mean cooked firmness (Table 8). In contrast, yellow peas had less cooked firmness compared to the 5- and 10-year mean values. The winter peas had a mean cooked firmness value below the firmness of cooked winter peas from 2021 but slightly higher than winter peas from 2022 and 2023. Among the green cultivars, Hampton and Arcadia had the lowest (6.7 N/g) and highest (23.2 N/g) cooked, respectively (Table 9). CDC Meadow and CDC Inca had the lowest (14.7 N/g) and highest (30.5 N/g) cooked firmness, respectively (Table 9). The winter peas had cooked firmness values that ranged from 10.1 to 22.7 N/g.

Color quality was measured using L*, a*, and b*, and from these values, a color difference can be determined between peas before and after soaking. **Color quality** for the pea samples in 2025 indicated that the green peas had L* values that were higher than the 5- and 10-year mean L* values (Table 10). The L* values for green peas in 2025 were higher than the L* values for peas from 2022-2024. Overall, the higher L* indicates that the green peas from the 2025 harvest were lighter in color than those from the previous harvest years. The negative number for a* value (i.e., red to green) in 2025 indicates slightly less green color compared to samples from 2022-2024 (Table 10). The a* value for green peas from 2025 was less than the 5- and 10-year mean a* values, indicating that the peas were less green compared to peas from other harvest years. The mean b* value (i.e., blue to yellow) for peas in 2025 was most comparable to the peas from 2023 but was lower than the other recent harvest years and the 5- and 10-year mean b* values. The lower b* value indicates a bluer color. The negative a*, combined with a lower b* value, indicates that the peas would be a blue-green color. Therefore, the green peas in 2025 appear blue green in color compared to peas that make up the 5- and 10-year long term, which would appear green yellow in color.

The mean L* value of yellow peas was comparable to the 5-year mean L* values and peas from 2022 and 2023 (Table 10). The L* value for yellow peas was higher than peas from 2024 and peas that made up the 10-year mean. This indicates yellow peas in 2025 were lighter than peas that made up the 10-year mean L* value.

Table 10. Color quality of dry pea grown in the USA before and after soaking in water 16 hours, 2022-2025 plus the 5- and 10-year mean values.

Color Scale*	Mean (SD) of Green Pea											
	Before Soaking						After Soaking					
	2025	2024	2023	2022	5-Year	10-Year	2025	2024	2023	2022	5-Year	10-Year
L (lightness)	59.04 (1.72)	56.68 (4.78)	58.27 (2.11)	58.45 (2.23)	57.91 (0.78)	55.73 (3.94)	54.10 (2.79)	50.79 (4.24)	52.93 (3.72)	52.55 (2.15)	52.87 (1.27)	51.25 (3.63)
a (red-green)	-0.70 (0.85)	-1.82 (1.37)	-1.25 (1.73)	-1.97 (0.56)	-1.72 (0.37)	-1.87 (0.71)	-5.84 (2.06)	-7.52 (2.19)	-6.65 (3.11)	-7.40 (0.59)	-7.09 (0.44)	-6.74 (1.11)
b (yellow-blue)	9.61 (0.83)	9.84 (1.88)	9.63 (1.64)	10.16 (0.68)	9.92 (0.20)	11.74 (2.41)	18.65 (1.45)	16.96 (3.19)	18.01 (3.44)	17.73 (1.98)	17.26 (0.67)	20.61 (5.47)
Color Difference	11.75 (1.11)	12.82 (2.99)	11.78 (1.59)	11.10 (1.98)	11.10 (1.25)	12.04 (2.90)						
Color Scale	**Mean (SD) of Yellow Pea**											
	Before Soaking						**After Soaking**					
	2025	**2024**	**2023**	**2022**	**5-Year**	**10-Year**	**2025**	**2024**	**2023**	**2022**	**5-Year**	**10-Year**
L (lightness)	63.21 (1.05)	61.48 (4.34)	63.45 (1.35)	63.57 (1.34)	63.01 (0.79)	61.80 (4.08)	62.64 (0.91)	62.23 (3.12)	62.73 (1.44)	62.54 (1.13)	63.52 (1.04)	63.52 (3.01)
a (red-green)	4.88 (0.58)	4.34 (0.97)	4.97 (0.50)	4.80 (0.95)	4.68 (0.30)	5.58 (1.08)	5.55 (0.79)	4.77 (1.04)	5.16 (0.61)	4.74 (0.65)	5.07 (0.28)	5.95 (1.93)
b (yellow-blue)	14.33 (1.15)	14.39 (2.14)	15.34 (0.59)	15.53 (0.33)	14.32 (1.36)	16.70 (3.12)	29.79 (1.37)	29.63 (3.79)	31.04 (2.71)	29.76 (0.62)	22.28 (3.18)	30.27 (5.66)
Color Difference	15.52 (1.81)	16.61 (3.55)	16.31 (0.99)	14.29 (0.50)	15.07 (1.19)	15.00 (3.85)						

*color scale: L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. **Winter peas were grouped into green or yellow.

Table 11. Color quality of USA dry pea cultivars before and after soaking, 2025.

		Mean Color Values*						
		Before Soaking			After Soaking			Color
Market Class	Cultivar	L	a	b	L	a	b	Difference
Green	Arcadia	59.10	-0.46	9.71	54.78	-5.44	18.52	11.20
	Ariel**	59.07	-1.80	8.22	50.38	-9.06	17.74	14.79
	Banner	54.88	-1.00	9.64	47.37	-6.37	16.29	11.44
	Hampton**	58.96	-0.42	10.02	55.13	-5.34	19.17	11.10
	Passion	58.12	-1.67	9.35	50.49	-8.61	18.03	13.52
	PG Greenback	61.23	0.11	10.44	57.24	-3.29	19.92	10.94
	Ultra**	56.05	-2.51	9.61	49.13	-8.67	18.76	13.03
Yellow	AAC Chrome**	62.97	5.43	15.09	61.77	7.13	32.02	17.06
	AAC IronHorse	62.20	4.31	13.74	61.68	5.04	31.08	17.37
	AAC Julius	61.94	5.85	15.25	61.86	6.62	31.37	16.16
	CDC Inca	63.52	5.34	14.59	61.99	6.99	30.49	16.07
	CDC Meadow	63.58	4.44	13.36	62.26	5.43	30.33	17.06
	Iconic**	60.91	6.11	15.53	62.12	5.35	28.95	13.50
	Treasure	63.35	4.73	14.11	63.21	5.30	28.97	14.90
Winter Green	Vail**	56.21	-2.31	7.77	47.21	-9.00	17.14	14.61
Winter Yellow	Blaze	60.75	2.40	13.88	59.77	3.03	29.83	16.01
	Winterberry**	62.56	5.20	13.16	61.70	6.67	30.94	17.87
Mottled/Maple	n/p**	48.17	4.34	7.25	48.64	6.05	16.38	9.30

*color scale: L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. **Only one sample of cultivar tested. n/p = not provided

The a* value of the yellow peas was on the red side of the scale, indicating the lack of a green appearance. The yellow pea in 2025 had a* values that were like the a* values in peas from 2022 and the 5-year mean value. However, the a* values for yellow peas from 2025 were less than the 10-year mean a* value (Table 10). Similarly, the b* values for peas in 2025 were less than the 10-year mean b* value but comparable to the 5-year mean b* value. This indicates that the peas from 2025 were similar in yellowness compared to the 5-year mean but less yellow compared to samples that made up the 10-year mean. The b* value for the peas from 2025 was lower than for peas from 2022 and 2023, but similar to the b* value of peas from 2024. This indicates that the yellowness of peas from 2025 was less than that of peas from 2022 and 2023, but similar to the peas from 2024 and the peas that made up the 5-year mean b* value. A higher b* value combined with an a* value on the red part of the scale indicates that the samples would be light yellow in color. A lower a* combined with a lower b* value indicates that the pulses would be a darker yellow to light brown color. Therefore, the yellow peas in 2025 appeared light yellow in color compared to peas from 2022 and 2023.

The color of the dry peas changed after the soaking process. The change in color as measured by color difference was less for green peas from 2025 compared to the peas from 2024 (Table 10). The green peas became darker (lower L*) while the a* value became more negative (i.e., greener), and more yellow (i.e., increased b* value). This trend was like previous crop years. In 2025, b* value increased significantly and likely is the main contributor for the color difference after soaking the green peas. The color changes (11.75) were more than the 5-year mean but less than the 10-year mean (Table 10). However, the 5 and 10-year mean L* value indicates lighter peas after soaking compared to the samples from 2025. Change in greenness and yellowness of the green peas suggests that the peas appeared greener after soaking (Table 10), but less green compared to peas that made up the 5- and 10-year mean color values.

The color difference between dry and soaked yellow peas was greater in peas from 2025 compared to peas from 2022 and the 5- and 10-year mean values. The yellow peas underwent more color change during soaking than did the green peas (Table 10). Although color difference is a general indicator of change, visual observations support an increase in yellowness (increased b*) after the soaking process in the yellow peas. The soaked peas from 2025 had L* values that were comparable to the peas from 2022-2024 and lower than the peas 5- and 10-year mean values (Table 10). This indicates that the yellowness (b*) of the soaked yellow peas was slightly less intense compared to the soaked peas that made up the 5- and 10-year mean b* value. The increased a* indicates a slight darkening toward a dark yellow compared to light yellow. The peas in 2025 had mean a* values that were higher than peas from other years except for peas that made up the 10-year mean sample.

The Banner cultivar had the lowest L* value (Table 11) among green peas. Ultra had the most negative a* value. PG Greenback the highest L* and b* values and the lowest a*. This combination contributed to the pale green color of the dry sample. As expected, the L* value decreased in all cultivars upon soaking. Again, this supports a darkening of green peas. The a* values became more negative (i.e., greener) and more yellow (i.e., increased b* value) after soaking. This combination of changes resulted in peas that appeared greener. Of the cultivars, PG Greenback and Ariel cultivars had the lowest and highest color difference value. The cultivars of the yellow peas had L* values between 60.91 and 63.58, with CDC Meadow being the lightest (Table 11). Treasure had the lightest color after soaking, while AAC IronHorse became the darkest (i.e., lowest L*). Of the cultivars, AAC IronHorse and CDC Meadows had the lowest redness (a*) and yellowness (b*) values, respectively. The highest a* and b* values were observed for the Iconic cultivar (Table 11). After soaking, AAC IronHorse cultivar had the lowest redness values, while AAC Chrome had the highest redness. AAC Chrome also had the highest yellowness values while Iconic had the lowest yellowness after soaking. The most significant color difference was observed in the AAC IronHorse cultivar, which likely resulted from the substantial increase in yellowness during soaking. Iconic had the least color change during soaking.

Two yellow winter cultivars had similar color values and the same tendency to change after soaking. However, Blaze underwent slightly less color change than Winterberry (Table 11). Of all peas tested, the mottled pea had the least color change.

Starch Properties (Tables 12-14)

The peas from 2025 had mean peak and hot paste viscosities values that were significantly higher than 5- and 10-year mean values for these same parameters (Table 12). Cold paste viscosity was also higher in the 2025 pea samples compared to the 5-year mean value but was lower than the 10-year mean cold paste viscosity. Mean peak time was comparable to the 5- and 10-year mean peak time values. This indicates that the samples begin to form a paste at the same time as most samples from the 5- and 10-year period. The pasting temperature of the samples ranged from 50.2-84.9 °C, with a mean of 77.7°C. The mean value is nearly 2 °C lower than the 5- and 10-year mean pasting temperatures. Only the cold paste viscosity of pea in 2025 was comparable to pea in 2021. No other pasting characteristics of peas in 2025 matched peas from other years, which tended to be higher in samples from 2025. The green and yellow peas had similar pasting properties, while the winter peas tended to have significantly lower viscosity values (Table 13).

Table 12. Starch characteristics of dry peas grown in the USA, 2021-2025 plus the 5- and 10-year mean values.

Starch Characteristic	2025 Range	2025 Mean (SD)	2024 Mean (SD)	2023 Mean (SD)	2022 Mean (SD)	2021 Mean (SD)	5-Year Mean (SD)	10-Year Mean (SD)
Peak Viscosity (RVU)	82-569	140 (45)	125 (19)	126 (22)	114 (23)	126 (17)	125 (7)	133 (10)
Hot Paste Viscosity (RVU)	81-375	128 (29)	112 (16)	116 (17)	105 (20)	118 (15)	115 (7)	122 (9)
Breakdown (RVU)	0-194	12 (18)	14 (12)	10 (7)	9 (5)	9 (5)	10 (2)	11 (3)
Cold Paste Viscosity (RVU)	114-426	196 (34)	139 (25)	162 (35)	176 (33)	204 (38)	182 (35)	209 (37)
Setback (RVU)	9-120	68 (19)	27 (16)	46 (20)	71 (15)	86 (24)	67 (31)	87 (30)
Peak Time (Minute)	4.60-7.00	5.45 (0.37)	5.48 (0.43)	5.51 (0.41)	5.94 (0.89)	5.37 (0.31)	5.52 (0.25)	5.27 (0.31)
Pasting Temperature (°C)	50.2-84.9	77.7 (5.8)	80.2 (2.3)	80.0 (1.7)	80.6 (2.8)	79.9 (1.8)	79.7 (1.1)	78.3 (1.8)
RVA Starch Gel Firmness (g)	101-371	272 (52)	193 (65)	270 (86)	243 (73)	**	nd	nd

**not previously reported; nd = not determined due to test not being performed for 5 or 10 years.

The pasting values for the yellow peas were slightly higher than the pasting viscosity for the green peas. For example, a mean cold paste viscosity of 200 RVU was recorded for the yellow peas, while values of 194 and 161 RVU were recorded for the green and winter peas, respectively (Table 13). For the green and yellow peas, pasting properties followed the same trend, where the 5- and 10-year mean hot paste and peak viscosities were higher for peas from 2025 compared to the 5- and 10-year mean values (Table 13). In contrast, the cold paste viscosities tended to be lower for all pea samples from 2025 compared to the 5- and 10-year means values. The pasting temperature was comparable between green peas from 2025, and the 5- and 10-year mean paste temperatures. In yellow pea, pasting temperature was approximately 1°C lower in 2025 compared to the 5- and 10-year mean pasting temperatures. Winter peas from 2025 had slightly higher pasting temperatures that the 5-year mean value. Collectively, the data indicate that the starch is behaving in a manner similar to that of the starch from peas in prior years. The RVA gel firmness was run again in 2025 (Tables 12-13). The gel firmness varied significantly (101-371 g), where winter pea produced a gel that was the least firm, while green and yellow pea samples had essentially the same mean (280 vs 271 g, respectively) RVA gel firmness (Tables 13).

Within each class, variability in starch characteristics was observed among cultivars. In the green pea, the Ariel cultivar had the highest peak, hot paste, and cold paste viscosities (Table 14). In contrast, the Hampton cultivar had the lowest peak and cold paste viscosities while Banner had the lowest hot paste viscosity. Iconic had the highest peak, hot paste, and cold paste viscosities among yellow cultivars. The lowest peak, hot paste, and cold paste viscosities in the yellow market class were observed in the Treasure and CDC Inca cultivars (Table 14).

The Vail and Winterberry winter peas had

Table 13. Starch characteristic of different market classes of dry peas grown in the USA, 2021-2025 plus 5- and 10-year mean values.

Physical Parameter	Mean (SD) of Green Pea 2025	2024	2023	2022	2021	5-year Mean (SD)	10-year Mean (SD)
Peak Viscosity (RVU)	137 (14)	125 (19)	131 (26)	131 (13)	127 (23)	134 (7)	137 (7)
Hot Paste Viscosity (RVU)	127 (11)	115 (16)	119 (21)	118 (13)	120 (20)	122 (4)	125 (5)
Breakdown (RVU)	11 (6)	10 (8)	11 (9)	13 (4)	6 (5)	12 (3)	11 (3)
Cold Paste Viscosity (RVU)	194 (25)	148 (26)	167 (45)	194 (28)	209 (53)	206 (27)	221 (26)
Setback (RVU)	68 (19)	33 (17)	48 (26)	75 (17)	89 (35)	83 (24)	96 (22)
Peak Time (Minute)	5.38 (0.24)	5.52 (0.36)	5.45 (0.35)	5.26 (0.21)	5.48 (0.40)	5.33 (0.13)	5.39 (0.36)
Pasting Temperature (°C)	78.8 (2.2)	80.7 (1.9)	80.3 (1.7)	79.4 (2.2)	80.4 (1.6)	79.1 (1.5)	78.2 (1.6)
RVA Gel Firmness (g)	280 (55)	194 (61)	266 (87)	249 (89)	**	nd	nd
Starch Characteristics	**Mean (SD) of Yellow Pea 2025**	**2024**	**2023**	**2022**	**2021**	**5-year Mean (SD)**	**10-year Mean (SD)**
Peak Viscosity (RVU)	142 (62)	126 (19)	122 (14)	127 (16)	130 (13)	132 (10)	136 (8)
Hot Paste Viscosity (RVU)	130 (39)	111 (16)	113 (13)	117 (13)	120 (12)	121 (7)	126 (7)
Breakdown (RVU)	13 (26)	15 (13)	9 44)	11 (6)	9 (4)	12 (3)	11 (2)
Cold Paste Viscosity (RVU)	200 (40)	134 (24)	157 (24)	196 (28)	205 (30)	204 (31)	221 (28)
Setback (RVU)	70 (19)	23 (13)	43 (14)	79 (15)	84 (19)	83 (26)	96 (22)
Peak Time (Minute)	5.49 (0.42)	5.47 (0.45)	5.39 (0.24)	5.22 (0.23)	5.37 (0.14)	5.27 (0.13)	5.26 (0.13)
Pasting Temperature (°C)	76.8 (7.2)	80.0 (2.5)	78.9 (1.15)	78.1 (1.6)	79.9 (0.7)	78.1 (1.5)	77.3 (1.5)
RVA Gel Firmness (g)	271 (41)	195 (69)	304 (74)	290 (71)	**	nd	nd
Physical Parameter	**Mean (SD) of Winter Pea 2025**	**2024**	**2023**	**2022**	**2021**	**5-year Mean (SD)**	**10-year Mean (SD)**
Peak Viscosity (RVU)	112 (26)	118 (9)	118 (21)	91 (13)	121 (14)	118 (16)	nd
Hot Paste Viscosity (RVU)	108 (23)	103 (9)	112 (18)	85 (13)	111 (12)	108 (13)	nd
Breakdown (RVU)	4 (4)	15 (13)	6 (6)	6 (2)	10 (6)	10 (4)	nd
Cold Paste Viscosity (RVU)	161 (41)	129 (20)	157 (30)	147 (19)	197 (28)	185 (31)	nd
Setback (RVU)	53 (20)	25 (11)	45 (13)	62 (7)	86 (19)	78 (24)	nd
Peak Time (Minute)	6.115 (0.52)	5.42 (0.37)	6.04 (0.60)	6.98 (0.05)	5.25 (0.33)	6.41 (2.03)	nd
Pasting Temperature (°C)	81.1 (2.7)	80.5 (1.4)	81.8 (1.4)	83.4 (0.7)	80.9 (2.2)	80.5 (2.4)	nd
RVA Gel Firmness (g)	174 (61)	167 (54)	186 (32)	203 (36)	**	nd	nd

**not previously reported; nd = not determined due to test not being performed for 5 or 10 years.

Table 14. Mean starch characteristics of dry pea cultivars grown in the USA in 2025.

Market Class	Cultivar	Peak Viscosity (RVU)	Hot Paste Viscosity (RVU)	Breakdown (RVU)	Cold Paste Viscosity (RVU)	Setback (RVU)	Peak Time (Min)	Pasting Temperature (°C)	Gel Firmness (g)
Green	Arcadia	135	126	9	190	64	5.39	78.6	261
	Ariel*	160	142	18	221	79	5.47	80.0	337
	Banner	128	115	13	173	58	5.30	79.9	346
	Hampton*	120	118	2	164	46	6.00	82.3	102
	Passion	151	135	16	216	80	5.39	79.3	304
	PG Greenback	124	119	4	190	70	5.35	77.5	289
	Ultra*	135	119	16	194	74	5.13	80.0	347
Yellow	AAC Chrome*	141	128	13	200	72	5.67	80.0	261
	AAC IronHorse	136	126	10	206	80	5.44	79.2	228
	AAC Julius	143	129	14	188	58	5.34	77.9	229
	CDC Inca	137	121	16	172	51	5.20	79.2	237
	CDC Meadow	144	133	11	203	70	5.47	80.0	265
	Iconic*	162	156	7	276	120	5.47	75.1	263
	Treasure	135	129	6	229	100	5.44	76.7	307
Winter Green	Vail*	98	96	2	138	42	6.13	84.9	146
Winter Yellow	Blaze	133	126	7	195	69	5.77	79.5	218
	Winterberry*	82	81	1	114	33	6.80	80.7	112
Mottled/Maple	n/p*	225	192	34	222	30	4.87	51.3	230

*Only one sample of cultivar tested. n/p = not provided.

similar peak, hot paste, and cold viscosities. However, Blaze had significantly higher peak, hot paste, and cold viscosities among winter peas. The breakdown ranged from 0 to 194 RVU, which represents a significant variability in breakdown value of the starch pastes. The setback values ranged from 9 to 120 RVU, which represents a small setback for some of the samples. A weak relation existed between cold paste viscosity, setback, and gel firmness. However, the make-up of the starch tends to contribute more to gel structure.

Functionality Properties (Tables 15-17)

Functionality property evaluation was new in 2022, and thus no 5-year mean values have yet to be determined. The emulsion activity and stability for all samples ranged from 49-59% (Table 15). The mean values of the emulsion properties for peas from 2025 were lower than that of peas from other crop years. The peas from the various classes had the same emulsion activity and stability (Table 16). Furthermore, no one cultivar had emulsion activity and stability values that were substantially different from those of others. Foaming capacity varied to a greater extent (87-247%). Differences in foaming capacity among different classes of peas were observed (Table 16); however, less variability was observed in the foam stability of the peas from different market classes. In contrast, at the cultivar level, differences in foaming capacity and stability were evident (Table 17). Among cultivars, Ultra and Hampton had the lowest and highest foaming capacity, respectively. Protein is the component that contributes to foaming properties and thus the higher foaming capacity of the Hampton cultivar likely relates high protein content. The highest water holding capacity was observed in Banner and Iconic cultivars. Only minor differences were present in oil holding capacity, with Winterberry having the highest value (0.36 g/g) and Banner the lowest (0.11 g/g).

Table 15. Functional properties of dry pea grown in the USA, 2022-2025.

Functional Properties	2025 Range	2025 Mean (SD)	2024 Mean (SD)	2023 Mean (SD)	2022 Mean (SD)
Emulsion Activity (%)	50-57	54 (1)	56 (1)	56 (1)	59 (1)
Emulsion Stability (%)	49-59	54 (2)	56 (1)	57 (1)	58 (2)
Foaming Capacity (%)	103-233	134 (15)	149 (35)	166 (29)	215 (27)
Foam Stability (%)	35-100	70 (8)	69 (16)	71 (11)	62 (10)
Water Holding Capacity (g/g)	0.89-1.27	1.04 (0.06)	1.70 (0.30)	1.30 (0.21)	1.28 (0.12)
Oil Holding Capacity (g/g)	0.14-0.38	0.23 (0.04)	0.20 (0.10)	0.21 (0.06)	0.37 (0.27)

Table 16. Functional properties of different classes of dry pea grown in the USA, 2022-2025.

Physical Parameter	2025	2024	2023	2022
Mean (SD) of Green Pea				
Emulsion Activity (%)	54 (1.4)	56 (1)	56 (1)	59 (1)
Emulsion Stability (%)	54 (2.0)	56 (1)	57 (1)	58 (1)
Foaming Capacity (%)	137 (18)	147 (32)	165 (27)	221 (33)
Foam Stability (%)	69 (8)	65 (17)	73 (9)	58 (9)
Water Holding Capacity (g/g)	1.06 (0.06)	1.57 (0.28)	1.3 (0.22)	1.34 (0.14)
Oil Holding Capacity (g/g)	0.23 (0.05)	0.27 (0.07)	0.20 (0.06)	0.17 (0.04)
Mean (SD) of Yellow Pea				
Emulsion Activity (%)	54 (1.2)	56(1)	56 (0.7)	59 (1)
Emulsion Stability (%)	54 (1.7)	56(1)	57 (0.8)	59 (1)
Foaming Capacity (%)	131 (12)	152(38)	168 (30)	208 (25)
Foam Stability (%)	71 (8)	71(17)	68 (10)	67 (14)
Water Holding Capacity (g/g)	1.03 (0.06)	1.75(0.29)	1.4 (0.16)	1.31 (0.10)
Oil Holding Capacity (g/g)	0.22 (0.04)	0.23(0.06)	0.22 (0.06)	0.16 (0.03)
Mean (SD) of Winter Pea				
Emulsion Activity (%)	54 (1.2)	57 (1)	56 (1)	58 (1)
Emulsion Stability (%)	52 (0.8)	56 (1)	57 (0.7)	58 (3)
Foaming Capacity (%)	121 (7)	128 (19)	162 (33)	215 (26)
Foam Stability (%)	76 (4)	79 (5)	72 (18)	63 (8)
Water Holding Capacity (g/g)	0.99 (0.07)	1.60 (0.16)	1.10 (0.13)	1.22 (0.11)
Oil Holding Capacity (g/g)	0.25 (0.08)	0.21 (0.04)	0.18 (0.05)	0.68 (0.15)

Table 17. Mean functional properties of dry pea cultivars grown in the USA, 2025.

Market Class	Cultivar	Emulsion Activity (%)	Emulsion Stability (%)	Foaming Capacity (%)	Foam Stability (%)	Water Holding Capacity (g/g)	Oil Holding Capacity (g/g)
Green	Arcadia	54	54	134	71	1.08	0.23
	Ariel*	53	55	130	67	1.02	0.20
	Banner	55	51	127	66	1.09	0.11
	Hampton*	53	54	170	71	1.06	0.28
	Passion	53	52	129	65	1.01	0.24
	PG Greenback	54	53	132	68	1.08	0.22
	Ultra*	55	54	113	75	1.00	0.27
Yellow	AAC Chrome*	55	53	123	63	0.99	0.21
	AAC IronHorse	54	53	121	74	0.99	0.23
	AAC Julius	55	54	130	71	1.04	0.23
	CDC Inca	53	54	132	61	1.00	0.23
	CDC Meadow	54	53	133	79	1.02	0.19
	Iconic*	55	54	130	56	1.09	0.22
	Treasure	55	54	142	68	1.00	0.16
Winter Green	Vail*	55	52	120	81	1.04	0.25
Winter Yellow	Blaze	54	52	117	75	0.94	0.20
	Winterberry*	53	53	130	73	1.02	0.36
Mottled/Maple	n/p*	55	54	123	60	1.04	0.24

*Only one sample of cultivar tested. n/p = not provided.

Lentil Quality Results

Sample Distribution

A total of 118 lentil samples were collected from Montana and Washington between August 2025 and October 2024. Samples were delivered to SDSU between December 2025 and January 2026. The growing location, number of samples, market class, and genotype details of these dry pea samples are provided in Table 18. CDC Richlea (48) accounted for most of the lentil samples. In addition, CDC Viceroy (13) and Pardina (13) accounted for the other significant number of samples evaluated in 2025. An additional twelve samples were included but location was not identified.

Table 18. Description of lentils used in the 2025 pulse quality survey.

State	No. of Samples	Market Class	Cultivars	
Montana	89	Black	Beluga	
		Green	Avondale	CDC Richlea
			CDC Viceroy	Greenstar
			Kermit	Laird
		Red	CDC Impala	Crimson
			Red Chiefs	
Washington	17	Green	Merrit	
		Spanish Brown	Pardina	

Proximate composition of lentils (Tables 19-21)

Moisture

The moisture content of lentils ranged from 6.4 to 12.2% in 2025 (Table 19). The mean moisture content (9.2%) was higher than the 5- and 10-year mean moisture content of 8.5 and 8.6%, respectively. In general, the mean moisture in 2025 was higher than mean moisture values of peas from previous year, but comparable to the lentils from 2023. Overall, all samples evaluated had moisture contents below the 13-14% recommended maximum for general storability. The moisture contents of the different classes were between 7.2 and 9.8% (Table 20). The green and red lentils had mean moisture contents of 9.4% and 9.8%, respectively, while Spanish brown lentils had moisture contents of 7.2%. The green lentils from 2025 had moisture contents that were higher than the 5- and 10-year mean moisture contents of 8.7 and 9.1%, respectively. The mean moisture content of green lentils from 2025 was similar to that of green lentils from 2023. Spanish brown lentils had a mean moisture content that was lower than the 5-and 10-year mean values, but lower than lentils from 2021 - 2024. The red lentils had a mean moisture content that was higher than the 5- and 10-year mean moisture contents of 8.8 and 9.1%, respectively.
The highest mean moisture contents were observed in the Greenstar (10.1%) cultivar (i.e., green lentil) while the Pardina (7.8%) cultivar had the lowest moisture content among Spanish brown lentils (Table 21). A French green lentil had the lowest of all lentils at a moisture of 6.6%.

Ash

The ash content of lentils ranged from 1.8 to 3.6% with a mean of 2.4% (Table 19). The mean ash content of lentils grown in 2025 was comparable to the 5- and 10-year mean ash contents of 2.6%. Ash content is a general indicator of minerals present. The mean ash contents of the green, red, and Spanish brown market classes were 2.4, 2.3, and 2.7%, respectively (Table 20). In general, the green and red lentils had mean ash values that were slightly less than their respective 5- and 10-year mean ash contents. Spanish Brown lentils had ash contents that matched their 5- and 10-year mean values. The Beluga (black), Merrit (green) and Pardina (Spanish brown) cultivars had the highest (2.6%) ash contents among known cultivars evaluated (Table 21). An unknown cultivar of French Green lentils did have the highest ash content (2.9%). CDC Impala (Red) had the lowest (1.8%) ash content.

Fat

The fat content of lentils ranged from 0.1 to 1.5% with a mean of 0.8% (Table 19). The fat content was lower than the 5-year mean fat content of 1.0%. The mean fat content of lentils from 2025 was similar to the fat content in lentils from prior years. Literature indicates that lentils have fat contents between 1 and 3%; therefore, the fat content of the lentils grown in 2025 falls at the lower end of the range reported by others. Only minor differences in fat percentages were observed between the different market classes (Table 20). Differences in the mean fat contents were observed among the cultivars (Table 21). CDC Richlea and Greenstar had the lowest (0.4%) highest (1.3%) fat contents among known cultivars. Like previous years, this data supports the consistent low-fat content of lentils.

Table 19. Proximate composition of lentils grown in the USA, 2021-2025 plus 5- and 10-year mean values.

Proximate Composition (%)*	2025 Range	2025 Mean (SD)	Mean (SD) 2024	2023	2022	2021	5-year	10-year
Moisture	6.4-12.2	9.2 (1.3)	8.9 (1.1)	9.0 (1.3)	8.5 (0.6)	8.0 (0.9)	8.5 (0.4)	8.6 (0.8)
Ash	1.8-3.6	2.4 (0.3)	2.6 (0.3)	2.5 (0.3)	2.8 (0.2)	2.7 (0.3)	2.6 (0.1)	2.6 (0.1)
Fat	0.1-1.5	0.8 (0.3)	0.8 (0.2)	1.0 (0.2)	1.0 (0.1)	0.9 (0.1)	1.0 (0.2)	n.d.
Protein	19.4-28.5	23.5 (1.6)	25.1 (1.5)	24.2 (1.7)	24.9 (1.4)	24.5 (1.3)	24.7 (0.4)	24.0 (1.0)
Total Starch	36.6-51.3	45.5 (2.4)	42.2 (3.5)	41.1 (2.3)	40.9 (1.7)	43.0 (2.0)	42.3 (1.4)	42.4 (1.9)

*composition is on an "as is" basis; nd = not determined due to test not being performed for 10 years.

Table 20. Proximate composition of different market classes of lentils grown in the USA, 2021-2025 plus 5- and 10-year means.

Market Class	Proximate Composition (%)	Mean (SD) 2025	2024	2023	2022	2021	5-Year	10-Year
Green	Moisture	9.4 (1.2)	9.1 (1.0)	9.4 (1.2)	8.6 (0.6)	8.1 (0.9)	8.7 (0.5)	9.1 (0.6)
	Ash	2.4 (0.2)	2.6 (0.2)	2.5 (0.3)	2.9 (0.1)	2.7 (0.3)	2.6 (0.2)	2.6 (0.2)
	Fat	0.7 (2.2)	0.8 (0.2)	1.0 (0.2)	1.0 (0.1)	0.9 (0.1)	1.0 (0.2)	nd
	Protein	23.3 (1.5)	25.2 (1.6)	24.3 (1.9)	25.7 (1.3)	24.9 (1.3)	24.9 (0.6)	24.1 (1.3)
	Total Starch	45.6 (2.3)	42.0 (3.6)	40.4 (2.2)	39.0 (1.2)	42.0 (1.3)	41.6 (2.1)	42.0 (2.1)
Red	Moisture	9.8 (1.0)	8.7 (0)	9.0 (0)	*	10.6 (0)	8.8 (1.2)	9.1 (1.0)
	Ash	2.3 (0.2)	2.1 (0)	2.8 (0)	*	2.5 (0)	2.6 (0.3)	2.6 (0.2)
	Fat	0.8 (0.2)	0.6 (0)	1.2 (0)	*	0.8 (0)	1.2 (0.6)	nd
	Protein	24.1 (1.2)	26.5 (0)	25.4 (0)	*	25.1 (0)	25.9 (0.6)	24.9 (1.2)
	Total Starch	44.7 (3.0)	38.0 (0)	42.6 (0)	*	39.2 (0)	41.2 (2.5)	41.8 (2.3)
Spanish Brown	Moisture	7.2 (0.5)	7.8 (0.3)	7.8 (0.4)	8.5 (0.6)	7.6 (0.4)	7.8 (0.4)	8.2 (0.7)
	Ash	2.7 (0.4)	2.6 (0.3)	2.7 (0.3)	2.8 (0.2)	2.8 (0.4)	2.7 (0.1)	2.7 (0.1)
	Fat	0.8 (0.2)	0.8 (0.1)	1.1 (0.1)	1.0 (0.1)	0.9 (0.1)	1.1 (0.3)	nd
	Protein	23.2 (0.7)	24.9 (1.2)	24.0 (0.4)	24.4 (1.2)	23.9 (1.3)	24.4 (0.5)	23.7 (1.2)
	Total Starch	46.4 (1.4)	43.5 (2.4)	42.7 (1.5)	41.8 (1.0)	44.6 (1.5)	43.3 (1.1)	42.7 (2.3)

* no red lentils evaluated in 2022, 5 and 10 year determination was done on 2019-24 and 2015-24 for green and Spanish brown lentils. For red lentil, the 5-year mean was based on 2019-2021 and 2023-24 while the 10-year mean was based on 2014-2021 and 2023-2024. nd = not determined due to test not being performed for 10 years.

Protein

Protein content of lentils ranged from 19.4 to 28.5% with a mean value of 23.5% (Table 19). The mean protein content of lentils grown in 2025 was lower than the 5- and 10-year mean protein content of 24.7 and 24.0%, respectively. The protein content of the red market class was higher than the mean protein for green and Spanish brown lentils (Table 20). Red lentils had a mean protein content (24.1%) that was higher than the other lentil classes. In addition, the mean protein contents of the green and Spanish brown lentils were lower than their respective 5- and 10-year mean protein values (Table 20). The mean protein content of lentils in 2025 did not closely align with the mean protein contents of lentils from other years. The Beluga (black) cultivar had the highest protein percentage (28.1%) among the tested cultivars (Table 21). The Greenstar lentils had the lowest protein content (22.5%) in 2025.

Table 21. Mean proximate composition of lentil cultivars grown in the USA in 2025.

Market Class	Cultivar	Concentration (%)* Moisture	Ash	Fat	Protein	Starch
Black	Beluga	9.1	2.6	1.0	28.1	44.4
French Green	n/p	6.6	2.9	0.7	25.3	41.3
Green	Avondale	9.4	2.4	0.6	24.0	45.9
	CDC Richlea	9.5	2.4	0.4	22.7	46.4
	CDC Viceroy	9.6	2.4	0.8	25.8	43.2
	Greenstar	10.1	2.2	1.3	22.5	44.9
	Kermit	8.9	2.2	0.6	23.2	45.3
	Laird	9.8	2.4	1.1	23.2	45.1
	Merrit	7.1	2.6	0.9	25.1	44.2
Red	CDC Impala**	8.8	1.8	0.6	26.6	46.0
	Crimson	9.8	2.1	1.1	22.8	47.7
	Red Chief**	8.6	2.2	1.2	25.5	44.2
Spanish Brown	Pardina	7.8	2.6	0.8	24.9	43.6

*Composition is on an "as is" basis. **Only one sample of cultivar tested. n/p = not provided.

Total starch

Total starch content of lentils ranged from 36.6 to 51.3%, with a mean of 45.5% (Table 19). The mean total starch percentage of lentils grown in 2025 was higher than the starch percentage in lentils from the previous five and ten years. The mean 5-

and 10-year starch contents were 42.3 and 42.4%, respectively. The mean starch content in peas grown in 2025 was approximately 4 percentage points higher than the starch content of peas from 2022 and 2023, and 2.5 percentage points higher than that of lentils from 2021 and 2024. The Spanish brown (46.4%) and green (45.6%) had higher starch contents than the red lentils (44.7%) (Table 20). However, all classes of lentils produced in 2025 had mean starch contents that were higher than lentils from other crop years and their 5- and 10-year mean values. The starch content of 45.6% for the green lentils from 2025 was higher than the 5- and 10-year mean starch contents of 41.6 and 42.0%, respectively. In the Spanish brown market class, the mean starch content in 2025 was 46.4% while the 5- and 10-year mean starch contents were 43.3 and 42.7%, respectively (Table 20). The mean total starch content (46.4%) of the red lentils from 2025 was higher than the 5- and 10-year mean values of 43.3 and 42.7%, respectively. The highest mean starch content was observed in the Crimson cultivar at 47.7% (Table 21). The French green lentil had the lowest mean starch content (41.3%) among samples evaluated. The cultivars with the highest protein contents generally had the lowest starch contents, thus supporting the assumption that the higher protein percentage contributed to the lower starch percentage as in the case of the Crimson cultivar for example.

Physical parameters of lentils (Tables 22-24)

Test weight, 1000-seed weight, water hydration capacity, percentage unhydrated seeds, swelling capacity, cooking firmness, and color represent the physical parameters used to define physical quality. **Test weight** ranged from 55.8 to 68.2 lbs./Bu with a mean of 61.7 lbs./Bu. This mean value was lower than the 5- and 10-year mean test weights of 63.9 and 63.1 lbs./Bu, respectively (Table 22). The mean test weight of lentils in the red and Spanish brown market classes were approximately 4 percentage points higher than test weights of lentils from the green class (Table 23). The mean test weight for lentils in the Spanish brown and green market classes in 2025 was lower than their respective 5- and 10-year mean test weights. In contrast, the lentils in the red class from 2025 had a higher mean test weight compared to the 5- and 10-year mean test weights. The Beluga cultivar had the highest mean test weight of 64.9 lbs./Bu, while Merrit had the lowest test weight of 59.1 lbs./Bu (Table 24).

Table 22. Physical parameters of lentils grown in the USA, 2021-2025 plus 5- and 10-year means.

Physical Parameters	2025		Mean (SD)					
	Range	Mean (SD)	2024	2023	2022	2021	5-year	10-year
Test Weight (lb/Bu)	55.8-68.2	61.7 (2.4)	63.2 (1.9)	63.5 (2.3)	64.1 (2.6)	64.3 (2.9)	63.9 (0.5)	63.1 (0.8)
1000 Seed Wt (g)	22-78	47 (12)	47 (10)	52 (12)	40 (11)	45 (13)	46 (4)	45 (3)
Water Hydration Capacity (%)	71-111	91 (7)	104 (14)	97 (13)	94 (8)	87 (8)	95 (6)	97 (9)
Unhydrated Seeds (%)	0-23	4 (5)	4 (4)	10 (10)	9 (7)	4 (4)	6 (3)	4 (3)
Swelling Capacity (%)	35-267	126 (25)	127 (21.0)	156 (23)	101 (18)	98 (15)	120 (23)	132 (23)
Cooked Firmness (N/g)	8.0-33.2	15.9 (4.6)	13.5 (2.2)	17.8 (3.6)	17.9 (4.1)	19.8 (4.2)	17.8 (2.6)	16.0 (2.8)

The range and mean **1000-seed weight** of lentils grown in 2025 were 22 to 78 g and 47.0 g, respectively (Table 22). The mean 1000-seed weight was higher than the 5- and 10-year mean values of 46 and 45 g, respectively. This data supports a similar seed size of the lentils in 2025 compared to longer-term averages. Lentils from the green market class had a mean 1000-seed weight of approximately 50 g, which is lower than the mean 1000 seed weight for green lentils grown in 2020-2023 but the same as lentils from 2024. The mean 1000-seed weight of the green lentils was the same as the 10-year mean value but slightly less than the 5-mean value (Table 23). The red lentils from 2025 had lower mean 1000-seed weights than the 5- and 10-year mean 1000 weight values. A slightly lower (35 g) 1000-seed weight was observed in 2025 in the Spanish Brown class compared to the 5- and 10-year mean values of 36 and 37 g, respectively. The lentil weights from the green and Spanish brown classes support smaller seed size compared to previous evaluations. These smaller seeds are likely reflected in the specific cultivar differences evaluated in 2025 compared to other years. The Pardina cultivar had the lowest (35 g) 1000-seed weight of the known cultivar. However, a French green lentil evaluated had a 1000-seed weight of 31 g. Greenstar had the highest (73.6 g) mean 1000-seed weight among lentils from 2025 (Table 24). Laird had the second highest 1000-seed weight (62.4 g). This variety had the highest 1000-seed weight in 2023 and 2024, supporting the large size of this lentil.

Water hydration capacity of lentils ranged from 71 to 111%, with a mean of 91% (Table 22). The mean water hydration capacity value of lentils from 2025 was lower than the lentils that made up the 5- and 10-year mean water hydration capacity of 95 and 97%, respectively. The water hydration capacity (92%) was highest for the green lentils, while the Spanish brown market classes had the lowest (84%) water hydration capacities (Table 23). The green lentils from 2025 had water hydration capacities that were comparable to the 5-mean value but lower than the 10-year mean value. Red lentils had a mean water hydration capacity (89%) that was lower than the 5- and 10-year mean values of 114 and 105, respectively. Spanish brown lentils also had lower water hydration capacity (84%) than the 5- and 10-year mean value of 90 and 94%, respectively (Table 23). The mean water hydration capacity ranged from 84% to 105% in Pardina and Red Chief cultivars, respectively (Table 24).

Table 23. Physical parameters of different market classes of lentils grown in the USA, 2021-2025 plus 5- and 10-year mean values.

Market class	Physical Parameter	Mean (SD) 2025	2024	2023	2022	2021	5-Year	10-Year
Green	Test Weight (lb/Bu)	60.7 (1.8)	62.8 (1.8)	62.9 (2.3)	61.0 (1.8)	62.3 (2.5)	62.5 (1.0)	62.1 (0.8)
	1000 Seed Wt (g)	50.2 (12.3)	49.7 (9.4)	57 (9)	55 (3)	51 (13)	53 (3)	50 (4)
	Water Hydration Capacity (%)	92 (6)	105 (14)	98 (12)	99 (7)	85 (9)	95 (8)	104 (17)
	Unhydrated Seeds (%)	2 (4)	4 (4)	9 (11)	3 (3)	3 (3)	5 (3)	3 (3)
	Swelling Capacity (%)	127 (26)	129 (21)	164 (19)	116 (19)	97 (13)	125 (25)	131 (22)
	Cooked Firmness (N/g)	16.7 (4.7)	13.5 (2.3)	17.2 (3.0)	16.6 (1.4)	19.7 (4.7)	17.2 (2.5)	15.7 (2.4)
Red	Test Weight (lb/Bu)	64.4 (2.0)	61.9 (0.0)	64.1 (0.0)	*	64.7 (0)	63.8 (1.1)	63.0 (1)
	1000 Seed Wt (g)	39.9 (6.7)	44 (0)	49 (0)	*	63 (0)	47 (10)	44 (9)
	Water Hydration Capacity (%)	89 (7)	105 (0)	107 (0)	*	93 (0)	114 (19)	105 (16)
	Unhydrated Seeds (%)	4 (5)	0 (0)	2 (0)	*	3 (0)	4 (3)	3 (2)
	Swelling Capacity (%)	128 (28)	105 (0)	177 (0)	*	128 (0)	138 (26)	135 (22)
	Cooked Firmness (N/g)	13.9 (4.1)	14.6 (0.0)	12.2 (0.0)	*	19.6 (0)	16.6 (3.9)	15.4 (3.3)
Spanish Brown	Test Weight (lb/Bu)	64.2 (1.1)	65.7 (0.4)	65.0 (1.7)	65.7 (1.0)	66.7 (0.7)	65.8 (0.6)	65.1 (1.3)
	1000 Seed Wt (g)	35.2 (1.4)	33.9 (1.0)	39 (6)	32 (2)	35 (3)	36 (4)	37 (4)
	Water Hydration Capacity (%)	84 (6)	95 (10)	93 (15)	92 (8)	88 (6)	90 (6)	94 (13)
	Unhydrated Seeds (%)	12 (6)	8 (4)	14 (6)	12 (6)	6 (3)	9 (4)	7 (4)
	Swelling Capacity (%)	113 (14)	116 (16)	132 (19)	93 (12)	97 (16)	109 (16)	128 (29)
	Cooked Firmness (N/g)	14.8 (3.5)	13.7 (1.3)	20.0 (4.0)	18.5 (4.9)	19.8 (4.0)	18.7 (3.0)	16.3 (3.6)

* no red lentils evaluated in 2022, 5 and 10 year determination was done on 2019-24 and 2015-24 for green and Spanish brown lentils. For red lentil, the 5-year mean was based on 2019-2021 and 2023-24 while the 10-year mean was based on 2014-2021 and 2023-2024.

Unhydrated seed percentage ranged from 0 to 23% with a mean of 4%, which is lower than the 5-year mean value of 6% but the same as the 10-year mean of 4% (Table 22). Many samples had unhydrated seed rates around 0%, which likely contributed to the 4% unhydrated seed rate in 2025 by offsetting the few samples with high unhydrated levels. The mean unhydrated seeds varied from 2% in green lentils to 12% in Spanish Brown (Table 23). The green lentils from 2025 had a mean unhydrated seed percentage that was comparable to the 5- and 10-year mean unhydrated seed percentage of 3% and 5%, respectively. For the Spanish brown lentils, the unhydrated seed count (12%) was higher than to the 5- and 10-year mean unhydrated seed percentage (9 and 7%, respectively). The red lentils had unhydrated seed rates that were comparable to their 5- and 10-year mean unhydrated seed percentage (4 and 3%, respectively). The CDC Viceroy, Greenstar, and Kermit cultivars all had 0% unhydrated seed percentages, while the Merrit and Pardina cultivars had the highest mean unhydrated seed weight of 12% (Table 24). The unhydrated seed percentage follows the trends from previous years, where the Spanish brown seeds tended to hydrate less than the green and red lentils. However, the lentils in 2025 tended to hydrate like lentils from 2024.

The **swelling capacity** of all lentils ranged from 35 to 267%, with a mean value of 126% (Table 22). The mean swelling capacity from 2025 samples was comparable to the lentils that made up the 5- and 10-year mean swelling capacities. The mean swelling capacity of lentils from the green market class was 127% (Table 23). The swelling capacity of the green lentils was most comparable to lentils that made up the 5- and 10-year mean swelling capacities of 125 and 131%, respectively. The swelling capacity (128%) of red lentils was the same as lentils from 2021 but slightly lower than that of lentils that made up the 5- and 10-year mean swelling capacity of 138 and 135%, respectively. The mean swelling capacity (113%) of the Spanish brown lentils in 2025 was similar to the mean swelling capacity (109%) for the Spanish brown lentils that made up the 5-year mean swelling capacity. Additionally, the mean swelling capacity of the Spanish brown lentils in 2025 was significantly lower than the 10-year mean swelling capacity (Table 23). The highest swelling capacity (178%) was observed in the Greenstar cultivar, while the Pardina cultivar had the lowest (113%) mean swelling capacity (Table 24). The reason for this might be due to the low water uptake as supported by low water hydration capacity of Pardina.

Table 24. Mean physical parameters of USA lentil cultivars grown in 2025.

Market Class	Cultivar	Test Weight (lb/bu)	1000 Seed Wt (g)	Water Hydration Capacity (%)	Unhydrated Seeds (%)	Swelling Capacity (%)	Cooked Firmness (N/g)
Black	Beluga	64.9	46.0	94	2	144	10.8
French Green	n/p*	64.9	31.1	91	2	138	13.6
Green	Avondale	60.8	49.4	91	4	114	14.1
	CDC Richlea	60.7	49.3	92	2	120	16.6
	CDC Viceroy	62.6	29.9	91	0	137	10.7
	Greenstar	60.4	73.6	92	0	178	27.2
	Kermit	61.3	46.2	97	0	147	17.5
	Laird	59.4	62.4	96	1	131	21.1
	Merrit	59.1	62.3	89	12	129	19.7
Red	CDC Impala*	60.8	29.6	99	1	138	13.5
	Crimson	62.8	42.5	87	2	133	18.1
	Red Chief*	60.4	48.5	105	1	129	17.1
Spanish Brown	Pardina	64.2	35.2	84	12	113	14.8

*Only one sample of cultivar tested. n/p = not provided with sample.

The **cooked firmness** of all lentils ranged from 8.0 to 33.2 N/g with a mean value of 15.9 N/g (Table 22). The lentils from 2025 had lower cooked firmness values than the 5-year mean cooked firmness value (17.8 N/g) and the same value as the 10-year mean cooked firmness value (16.0 N/g). The cooked firmness of lentils was not different between the lentil classes. Green lentils had the highest (16.7 N/g) cooked firmness while the red lentils had cooked firmness values that were nearly two percentage points lower than the values from the green lentils (Table 23). The green lentils had a mean cooked firmness value (16.7 N/g) that was lower and higher than the 5- and 10-year mean cooked firmness values of 17.2 and 15.7 N/g, respectively. In contrast, the red lentils had a mean cooked firmness of 13.9 N/g, which is lower than the cooked firmness of samples that made up the 5- and 10-year mean values. The mean cooked firmness (14.8 N/g) of Spanish brown lentils was nearly 4 N/g lower for the lentils from 2025 compared to the 5-year mean value. Among the cultivars, Greenstar had the highest cooked firmness value while CDC Viceroy had the lowest cooked firmness (Table 24). CDC Viceroy also had the lowest cooked firmness in 2024.

Color quality was measured using L*, a*, and b* values, and from these values, a color difference can be determined on lentils before and after soaking (Table 25). The color quality for lentils in 2025 indicated that the green and red lentils overall had higher L* values than lentils from previous years. However, the higher L* were more pronounced in the green lentils. This data indicates that the lentils from the 2025 crop year were lighter in color than those from recent years. The L* value of the green lentils was higher than the 5- and 10-year mean L* value, which supports a lighter color compared to long-term averages. The L* values of the red Spanish brown lentils were significantly higher than the 5- and 10-year mean L* values. The L* values were approximately 5 to 9 color units higher than in previous samples (Table 25). In 2025, the a* value of 5.12 of green lentils was higher than the 5- and 10-year mean a* values, indicating less greenness in lentils for the 2025 samples compared to long-term mean values. The mean a* value for the Spanish brown lentils was higher than the 5-year mean a* value, indicating more redness and thus darker brown. Similarly, the red lentils from 2025 had higher a* compared to the 5- and 10-year mean a* values, indicating more redness for the samples from 2025. The green lentils had a significantly higher mean b* value compared to the 5- and 10-year mean values, suggesting the 2025 samples were more yellow in nature. The Spanish brown a mean b* value for 2025 was higher than the b* value of samples from all years, including the samples that made up the 5- and 10-year mean b* values. This indicates that the lentils were light brown compared to the lentils from previous years, due to the higher yellowness of the lentils in 2025. The red lentils had higher b* values in 2025, supporting a lentil with a redder hue. The color of the lentils changed after the soaking process. Unlike previous years, the green lentil became lighter, as evidenced by the higher L* and b* values after soaking. Likewise, the soaked red and Spanish brown lentils became lighter compared to pre-soaked lentils (Table 25). In the red lentils, the increased a* value indicated an increase in redness. Lentils from all market classes became more yellow (i.e., increased b* value) after soaking. The color difference in lentil samples was comparable between green and Spanish brown market classes (Table 25). However, the color difference in red lentils was slightly higher. Overall, the colors

Table 25. Color quality of lentils grown in the USA before and after soaking, 2022-2025 plus 5- and 10-year mean values.

Color Scale	Mean (SD) of green lentils											
	Before Soaking						After Soaking					
	2025	2024	2023	2022	5-Year	10-year	2025	2024	2023	2022	5-Year	10-Year
L* (lightness)	71.90 (4.46)	60.33 (5.25)	57.75 (1.00)	58.82 (0.77)	58.75 (1.35)	56.43 (3.53)	79.44 (5.37)	58.50 (1.49)	58.51 (1.19)	59.02 (0.45)	58.57 (1.25)	58.13 (2.42)
a* (red-green)	5.12 (3.19)	1.19 (1.31)	1.87 (1.44)	2.72 (0.82)	1.96 (1.00)	2.72 (1.67)	3.40 (3.66)	-0.44 (1.40)	0.12 (1.83)	1.20 (1.33)	0.55 (1.02)	1.50 (2.06)
b* (yellow-blue)	26.55 (4.21)	13.37 (2.10)	14.07 (7.49)	11.73 (1.13)	13.36 (1.46)	16.64 (4.40)	47.27 (5.14)	24.25 (1.71)	24.64 (1.77)	19.93 (3.04)	20.71 (4.20)	24.73 (6.04)
Color Difference	22.60 (3.18)	12.16 (4.55)	10.82 (1.45)	8.38 (1.99)	9.03 (2.55)	9.14 (2.08)						

Color Scale*	Mean (SD) of red lentils											
	Before Soaking						After Soaking					
	2025	2024	2023	2022	5-Year	10-Year	2025	2024	2023	2022	5-Year	10-Year
L* (lightness)	61.27 (3.04)	61.21 (0)	51.17 (0)	**	53.19 (5.96)	52.21 (5.37)	65.78 (3.45)	57.17 (0)	50.36 (0)	**	53.19 (3.47)	52.17 (2.83)
a* (red-green)	7.51 (1.65)	2.96 (0)	4.14 (0)	**	3.37 (0.50)	4.75 (2.01)	16.73 (2.11)	7.56 (0)	7.60 (0)	**	7.07 (1.67)	9.19 (3.14)
b* (yellow-blue)	14.42 (2.71)	11.55 (0)	17.49 (0)	**	10.95 (4.41)	12.66 (4.47)	38.49 (3.23)	22.83 (0)	18.29 (0)	**	17.01 (4.78)	21.10 (5.92)
Color Difference	26.33 (2.58)	12.83 (0)	11.37 (0)	**	9.82 (3.25)	11.44 (3.78)						

Color Scale	Mean (SD) of brown lentils											
	Before Soaking						After Soaking					
	2025	2024	2023	2022	5- Year	10-Year	2025	2024	2023	2022	5-Year	10-Year
L* (lightness)	59.28 (1.67)	61.70 (6.86)	54.98 (0.98)	54.01 (0.36)	54.75 (4.18)	49.92 (7.13)	63.95 (2.17)	52.69 (1.19)	51.17 (1.09)	54.71 (0.73)	52.99 (1.38)	50.13 (4.47)
a* (red-green)	5.18 (0.86)	2.00 (0.52)	3.04 (0.37)	2.65 (0.23)	2.30 (1.03)	3.30 (1.70)	5.70 (1.07)	2.78 (0.42)	3.20 (0.60)	2.20 (0.43)	2.05 (1.69)	3.92 (2.61)
b* (yellow-blue)	11.22 (1.13)	5.95 (0.65)	7.27 (0.56)	6.78 (0.21)	7.11 (0.97)	9.76 (3.95)	33.18 (2.33)	16.42 (1.11)	10.74 (0.60)	15.42 (1.12)	12.93 (2.83)	18.33 (7.34)
Color Difference	22.68 (3.02)	15.27 (3.68)	10.81 (1.34)	8.69 (1.11)	8.78 (4.58)	10.86 (5.36)						

*color scale L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. Color difference = change in value before soaking and after soaking. **no red lentils evaluated in 2022, 5 and 10 year determination was done on 2019-24 and 2015-24 for green and Spanish brown lentils. For red lentil, the 5-year mean was based on 2019-2021 and 2023-24 while the 10-year mean was based on 2014-2021 and 2023-2024.

of lentils in 2025 were impacted (higher value) more by soaking in comparison to lentils that made up the 5- and 10-year mean color difference values. This was likely due to the significant increase in L* and b* values after soaking.

Beluga had the lowest L* value among the cultivars, followed by French green lentils (Table 26). This observation was anticipated since the Beluga is black lentil. The highest L* was observed in the Avondale cultivar. The L* values of lentils increased for all lentils after soaking (Table 26). This contrasted with lentils from prior years except for Spanish brown lentils. The green lentil cultivars became greener (i.e., reduction of the a* value) after soaking. The Avondale and CDC Viceroy had the greenest appearance (the most negative a* value). The green lentil cultivar Avondale had the highest b* value (i.e., yellowness) of the soaked lentils. This is a green-coated lentil, but it has a yellow cotyledon; thus, the soaking may have reduced the impact of the hull on color and resulted in increased yellowness. The red and Spanish Brown classes became redder in color after soaking. The Red Chief cultivar had the most significant increase in redness (a*). The increased b* values indicated that the lentils in all market classes became more yellow in color.

Table 26. Color quality of USA lentil cultivars before and after soaking, 2025.

Market Class	Cultivar	Mean Color Values*						
		Before Soaking			After Soaking			Color
		L*	a*	b*	L*	a*	b*	Difference
Black	Beluga	54.29	-0.15	11.08	59.36	0.26	27.63	17.70
French Green	n/p**	56.35	-1.89	10.36	64.01	-5.38	30.67	22.00
Green	Avondale	73.33	2.71	26.99	80.88	1.82	50.39	24.76
	CDC Richlea	71.68	4.99	26.86	78.93	2.72	46.93	21.91
	CDC Viceroy	70.26	4.06	25.40	79.70	1.85	47.37	24.28
	Greenstar	72.97	8.66	30.61	79.94	5.31	48.36	19.80
	Kermit	70.82	7.23	28.47	75.43	9.12	47.74	20.90
	Laird	72.39	5.19	27.60	82.39	3.22	49.39	24.34
	Merrit	71.51	8.18	21.55	76.51	6.36	40.05	19.76
Red	CDC Impala**	59.44	7.39	10.97	62.44	18.63	35.78	27.43
	Crimson	60.65	8.37	13.79	61.48	18.87	36.10	24.87
	Red Chief**	72.55	12.60	24.42	75.97	21.17	46.46	23.90
Spanish Brown	Pardina	59.28	5.18	11.22	63.95	5.70	33.18	22.68

*color scale L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. Color difference = change in value before soaking and after soaking. **Only one sample of cultivar tested. n/p = not provided with sample.

The change in lightness and yellowness contributed to the greatest color difference that was observed in the individual green and brown cultivars after soaking (Table 26). In the red cultivar, the change in redness (a*) and yellowness (b*) likely contributed most to the color difference value.

Pasting properties (Tables 27-29)

Peak, hot paste, and cold paste viscosities of lentils grown in 2025 were higher than their respective values from prior years including the values of the 5- and 10-year mean values. However, the viscosity data was most similar to the 10-year mean value. For example, peak viscosity (138 RVU) and hot paste viscosity (126 RVU) matched closely to the value (133 and 125 RVU) of the 10-year mean value. However, no cold paste viscosity was a close match to the 233 RVU value for the 2025 samples (Table 27). The pasting temperature ranged from 71.8 to 83.2 °C, with a mean value of 77.1 °C, which is lower than the 5- and 10-year mean pasting temperatures. The peak, hot paste, and cold paste viscosities were different among the market classes (Table 28). The peak, hot paste, and cold paste viscosities obtained for lentils in the green market class were lower than those of the lentils from the Spanish Brown and red market classes. Pasting characteristics for the green lentils in 2025 were most comparable to the 10-year mean viscosity values for peak, hot paste, and cold paste viscosities. In contrast, peak, hot paste and cold paste viscosities were higher than their respective 5- and 10-year mean viscosity values for the red and Spanish brown lentils (Table 28). For the red and Spanish Brown lentils, the higher mean viscosity values indicate that the lentils from 2025 produce thicker pastes than samples from previous years.

Table 27. Starch characteristics of lentils grown in the USA, 2021-2025 plus 5- and 10-year mean values.

Starch Characteristic	2025		Means (SD)					
	Range	Mean (SD)	2024	2023	2022	2021	5-Year	10-year
Peak Viscosity (RVU)	70-191	138 (25)	128 (20)	118 (32)	124 (19)	117 (23)	126 (10)	133 (12)
Hot Paste Viscosity (RVU)	52-165	126 (22)	123 (17)	110 (26)	120 (18)	110 (23)	119 (10)	125 (11)
Breakdown (RVU)	1-34	12 (9)	6 (5)	7 (10)	4 (3)	7 (7)	7 (2)	8 (3)
Cold Paste Viscosity (RVU)	88-355	233 (43)	149 (22)	151 (39)	221 (32)	210 (50)	194 (41)	216 (39)
Setback (RVU)	37-190	107 (26)	28 (11)	39 (19)	101 (16)	100 (28)	74 (37)	91 (32)
Peak Time (Minute)	4.20-7.00	5.32 (0.63)	5.89 (0.56)	6.09 (0.58)	6.46 (0.56)	6.10 (0.76)	6.05 (0.29)	5.84 (0.36)
Pasting Temperature (°C)	71.8-83.2	77.1 (2.4)	80.2 (2.6)	79.8 (1.5)	80.2 (1.4)	80.0 (1.8)	79.1 (1.2)	78.1 (1.4)
RVA Gel Fimness (g)	146-466	320 (58)	174 (37)	255 (75)	285 (35)	**	238 (57)	nd

**not previously reported; nd = not determined due to test not being performed for 10 years.

The RVA gel firmness represents the strength of a gel that forms after heating and cooling of a pulse flour. The gel firmness ranged from 146 to 466 g, with a mean of 320 g (Table 27). The green and red lentils had the greatest gel firmness (Table 28). Overall, lentils had gel firmness values that were significantly higher in the 2025 harvest year compared to previous years, regardless of market class (Table 28).

Variability in pasting characteristics was observed among cultivars (Table 29). In the green market class, the variability among cultivars was noticeable. Kermit had the lowest peak, hot paste, and cold paste viscosities. The CDC Richlea lentils from 2025 had the highest peak, hot paste and cold paste viscosities. Crimson had significantly higher peak, hot paste, and cold paste viscosities among red lentils. Pardina had viscosity characteristics that were similar to those of Crimson.

The higher viscosity parameters of the aforementioned lentils translated into higher gel firmness values where Crimson, CDC Richlea and Pardina all had gel firmness values that were at the higher end of the gel firmness scale among the samples evaluated (Table 29).

Table 28. Starch characteristic of different market classes of lentils grown in the USA, 2021-2025 plus 5- and 10-year mean values.

Market class	Physical Parameter	Mean (SD) 2025	2024	2023	2022	2021	5-Year Mean (SD)	10-Year Mean (SD)
Green	Peak Viscosity (RVU)	134 (23)	130 (19)	119 (35)	110 (15)	111 (22)	123 (15)	132 (15)
	Hot Paste Viscosity (RVU)	121 (21)	124 (16)	110 (29)	105 (14)	103 (21)	115 (14)	124 (13)
	Breakdown (RVU)	12 (8)	6 (5)	9 (11)	5 (2)	8 (9)	8 (2)	9 (3)
	Cold Paste Viscosity (RVU)	226 (42)	151 (20)	148 (42)	194 (15)	193 (41)	185 (38)	212 (39)
	Setback (RVU)	106 (27)	27 (9)	38 (20)	89 (7)	90 (21)	70 (35)	88 (31)
	Peak Time (Minute)	5.24 (0.64)	5.84 (0.55)	5.97 (0.59)	6.55 (0.67)	6.11 (0.83)	6.00 (0.37)	5.78 (0.40)
	Pasting Temperature (°C)	77.0 (2.5)	80.3 (2.8)	79.4 (3.2)	81.2 (1.9)	80.6 (2.1)	80.0 (1.0)	78.5 (1.8)
	RVA Gel Firmness (g)	324 (61)	177 (37)	272 (62)	268 (34)	**	nd	nd
Red	Peak Viscosity (RVU)	156 (29)	128 (0)	77 (0)	*	97 (0)	121 (26)	120 (21)
	Hot Paste Viscosity (RVU)	139 (20)	126 (0)	77 (0)	*	84 (0)	116 (22)	115 (18)
	Breakdown (RVU)	17 (10)	2 (0)	0 (0)	*	13 (0)	5 (6)	5 (4)
	Cold Paste Viscosity (RVU)	251 (40)	166 (0)	107 (0)	*	132 (0)	191 (56)	198 (43)
	Setback (RVU)	112 (23)	40 (0)	30 (0)	*	48 (0)	75 (37)	83 (29)
	Peak Time (Minute)	5.44 (0.62)	7.00 (0)	6.57 (0)	*	5.27 (0)	6.25 (0.66)	6.56 (1.64)
	Pasting Temperature (°C)	76.9 (2.5)	81.5 (0)	81.5 (0)	*	79.2 (0)	79.8 (1.6)	78.5 (2.1)
	RVA Gel Firmness (g)	313 (50)	181 (0)	223 (0)	*	**	nd	nd
Spanish Brown	Peak Viscosity (RVU)	150 (15)	116 (20)	116 (22)	130 (17)	126 (24)	125 (10)	134 (14)
	Hot Paste Viscosity (RVU)	142 (9)	113 (17)	111 (18)	127 (15)	121 (23)	121 (9)	129 (12)
	Breakdown (RVU)	8 (6)	4 (3)	3 (2)	4 (3)	5 (4)	4 (1)	6 (3)
	Cold Paste Viscosity (RVU)	263 (33)	138 (33)	161 (25)	234 (30)	237 (49)	201 (48)	223 (42)
	Setback (RVU)	121 (24)	29 (19)	43 (15)	108 (16)	116 (27)	80 (40)	96 (34)
	Peak Time (Minute)	5.50 (0.40)	6.11 (0.52)	6.40 (0.41)	6.42 (0.50)	6.16 (0.68)	6.22 (0.18)	5.95 (0.42)
	Pasting Temperature (°C)	78.3 (0.7)	79.6 (1.3)	79.5 (0.5)	79.7 (0.5)	79.3 (1.0)	79.5 (0.1)	78.6 (1.3)
	RVA Gel Firmness (g)	325 (43)	154 (36)	208 (93)	293 (33)	**	nd	nd

* no red lentils evaluated in 2022, 5 and 10 year determination was done on 2019-24 and 2015-24 for green and Spanish brown lentils. For red lentil, the 5-year mean was based on 2019-2021 and 2023-24 while the 10-year mean was based on 2014-2021 and 2023-2024. **not previously measured; nd = not determined due to test not being performed for 5 or 10 years.

Table 29. Mean starch characteristics of lentil cultivars grown in the USA in 2025.

Market Class	Cultivar	Peak Viscosity (RVU)	Hot Paste Viscosity (RVU)	Breakdown (RVU)	Cold Paste Viscosity (RVU)	Setback (RVU)	Peak Time (Min)	Pasting Temperature (°C)	RVA Gel Firmnes (g)
Black	Beluga	136	128	8	202	74	5.73	76.6	281
French Green	n/p*	94	91	2	165	73	7.00	79.9	214
Green	Avondale	109	101	7	177	75	5.67	78.4	250
	CDC Richlea	141	127	15	244	119	5.11	76.8	347
	CDC Viceroy	134	122	12	215	93	5.76	76.8	271
	Greenstar	112	103	9	200	97	4.80	74.5	340
	Kermit	89	75	14	132	57	4.51	74.5	218
	Laird	122	111	11	199	88	4.99	75.5	310
	Merrit	119	116	3	197	81	5.95	79.0	298
Red	CDC Impala*	102	98	4	181	83	7.00	83.2	212
	Crimson	150	143	7	284	141	5.30	76.3	387
	Red Chief*	116	109	7	174	65	5.40	81.6	254
Spanish Brown	Pardina	150	142	8	263	121	5.50	78.3	325

*Only one sample of cultivar tested. n/p = not provided with sample.

Functional properties (Tables 30-32)

Functionality property evaluation was completed for the fourth time in 2025. These tests include emulsion activity and stability, foaming capacity and stability, water holding capacity, and oil holding capacity. The emulsion activity and stability for all lentil samples ranged from 49 to 58% and 41 to 59% (Table 30). These values were slightly lower than previous years. The lentils from the various market classes had comparable emulsion activity and stability, with the red lentils having slightly higher emulsion properties (Table 31). Furthermore, no individual cultivar had emulsion activity and stability values that were significantly different than those of other cultivars (Table 32).

Table 30. Functional properties of lentils grown in the USA, 2022-2025.

Functional Properties	2025 Range	2025 Mean (SD)	2024 Mean (SD)	2023 Mean (SD)	2022 Mean (SD)
Emulsion Activity (%)	49-58	53 (2)	57 (2)	55 (1)	59 (1)
Emulsion Stability (%)	41-59	52 (4)	57 (1)	56 (1)	59 (2)
Foaming Capacity (%)	103-183	134 (16)	138 (25)	180 (37)	205 (45)
Foam Stability (%)	49-101	76 (10)	75 (10)	76 (9)	67 (14)
Water Holding Capacity (g/g)	0.85-1.13	1.0 (0.05)	1.55 (0.21)	1.27 (0.14)	1.30 (0.16)
Oil Holding Capacity (g/g)	0.10-0.43	0.23 (0.05)	0.21 (0.05)	0.16 (0.06)	0.40 (0.28)

Table 31. Functional properties of different market classes of lentils grown in the USA, 2022-2025.

Market Class	Functional Properties	Mean (SD)			
		2025	2024	2023	2022
Green	Emulsion Activity (%)	53 (2)	57 (1)	55 (1)	58 (1)
	Emulsion Stability (%)	51 (5)	57 (1)	56 (1)	59 (2)
	Foaming Capacity (%)	134 (16)	136 (23)	189 (37)	189 (36)
	Foam Stability (%)	77 (9)	74 (9)	74 (9)	71 (12)
	Water Holding Capacity (g/g)	1.01 (0.04)	1.53 (0.21)	1.22 (0.10)	1.28 (0.11)
	Oil Holding Capacity (g/g)	0.23 (0.05)	0.22 (0.06)	0.16 (0.07)	0.29 (0.21)
Red	Emulsion Activity (%)	55 (92)	60 (0)	54 (0)	*
	Emulsion Stability (%)	55 (2)	58 (0)	55 (0)	*
	Foaming Capacity (%)	135 (18)	117 (0)	227 (0)	*
	Foam Stability (%)	77 (10)	74 (0)	73 (0)	*
	Water Holding Capacity (g/g)	1.03 (0.05)	1.55 (0)	1.19 (0)	*
	Oil Holding Capacity (g/g)	0.22 (0.02)	0.27 (0)	0.15 (0)	*
Spanish Brown	Emulsion Activity (%)	53 (0.6)	56 (2)	56 (1)	58 (1)
	Emulsion Stability (%)	54 (0.9)	56 (1)	56 (1)	59 (2)
	Foaming Capacity (%)	137 (13)	150 (32)	151 (16)	189 (36)
	Foam Stability (%)	67 (7)	79 (11)	80 (6)	71 (12)
	Water Holding Capacity (g/g)	0.94 (0.03)	1.67 (0.14)	1.41 (0.16)	1.28 (0.11)
	Oil Holding Capacity (g/g)	0.19 (0.04)	0.19 (0.03)	0.17 (0.05)	0.29 (0.21)

*No red lentils evaluated in 2022

In contrast to emulsion activity, foaming capacity varied to a greater extent (103-183%). Differences in foaming capacity among different classes of lentils was minimal (Table 31), with the Spanish Brown lentils having mean foaming capacities that were approximately two to three percentage points higher than the mean foaming capacity of the green and red lentils, respectively. In contrast, the Spanish brown lentils had foam stability that was approximately ten percentage points lower than the foaming stability of the green and red lentils. The Merrit and Laird cultivars had significantly higher foaming capacity (143 and 142%, respectively) compared to other lentils except French green (143%) (Table 32). However, CDC Impala had the highest foam stability. The Kermit and Laird cultivars had higher water holding capacity compared to the other cultivars. Beluga had a slightly higher oil holding capacity value compared to the other cultivars. Overall, water holding capacity and oil holding capacity were not substantially different among different market classes or cultivar (Table 31).

Table 32. Mean functional properties of lentil cultivars grown in the USA, 2025.

Market Class	Cultivar	Water Holding Capacity (g/g)	Oil Holding Capacity (g/g)	Emulsion Activity (%)	Emulsion Stability (%)	Foaming Capacity (%)	Foam Stability (%)
Black	Beluga	1.01	0.30	53	51	115	80
French Green	n/p*	0.85	0.20	54	54	143	67
Green	Avondale	1.01	0.27	53	50	124	85
	CDC Richlea	1.01	0.23	53	49	135	76
	CDC Viceroy	1.02	0.23	52	51	128	78
	Greenstar	1.02	0.21	53	53	137	71
	Kermit	1.03	0.24	50	53	132	76
	Laird	1.03	0.27	54	48	142	77
	Merrit	0.93	0.21	53	54	143	75
Red	CDC Impala*	1.01	0.25	53	53	127	91
	Crimson	0.99	0.21	54	53	125	80
	Red Chief*	0.97	0.21	54	52	123	89
Spanish Brown	Pardina	0.94	0.19	53	54	137	67

*Only one sample of cultivar tested. n/p = not provided with sample.

Chickpea Quality Results

Sample distribution

A total of 71 chickpea samples were collected from Idaho, Montana, and Washington between September 2025 and November 2025. Samples were delivered to SDSU between December 2025 and January 2026. The growing location, number of samples, market class, and genotype details of these dry chickpea samples are provided in Table 33. CDC Leader (4), CDC Orion (9), and Sawyer (24) accounted for most of the chickpea of the known cultivars evaluated. In addition, several Desi chickpea samples were evaluated.

Table 33. Description of chickpea samples used in the 2025 pulse quality survey.

State	No. of Samples	Market Class	Cultivars	
Idaho	1	Kabuli	Sierra	
Montana	31	Kabuli	CDC Frontier	CDC Orion
			Kasin	CDC Leader
			Palmer	Sawyer
Washington	37	Kabuli	Billy Beans	CDC Frontier
			Dylan	Nash
			Quinn	Royal
			Sawyer	Sierra
Montana	2	Desi		

Proximate composition of chickpea (Tables 34-35)

The **moisture content** of chickpeas ranged from 5.1 to 11.5% in 2025 (Table 34). The mean moisture content of the samples was 7.8%, which is lower than the 5- and 10-year mean of 8.7 and 9.0%, respectively. This supports the fact that the long-term mean moisture content of the chickpea from the region is consistently lower than 13%, which is essential to maintain quality chickpea and proper storage. The CDC Leader cultivar had the highest mean moisture content at 9.1% while the Royal had the lowest moisture content (6.4%) among all chickpeas (Table 35).

The **ash content** of chickpeas ranged from 2.0 to 2.9% with a mean of 2.5% (Table 34). The mean ash content of chickpeas grown in 2025 was slightly lower than ash contents of chickpea that were used in determining the 5- and 10-year mean values (Table 34). Of the known cultivars, CDC Orion had the lowest ash contents at 2.3%, while Dylan had an ash content of 2.8%, thus indicating minimal variability of the ash composition (Table 35).

Table 34. Proximate composition of chickpeas grown in the USA, 2021-2025 plus 5- and 10-year mean values.

Proximate Composition*	Year 2025 Range	2025 Mean (SD)	2024 Mean (SD)	2023 Mean (SD)	2022 Mean (SD)	2021 Mean (SD)	5-year Mean (SD)	10-year Mean (SD)
Moisture (%)	5.1-11.5	7.8 (1.1)	9.5 (1.2)	8.8 (1.2)	8.5 (0.9)	8.5 (0.9)	8.7 (0.6)	9.0 (1.0)
Ash (%)	2.0-2.9	2.5 (0.2)	2.8 (0.2)	2.8 (0.3)	2.9 (0.1)	3.0 (0.2)	2.9 (0.1)	2.8 (0.1)
Fat (%)	4.8-7.1	5.9 (0.5)	5.3 (0.5)	5.3 (0.4)	5.6 (0.4)	5.6 (0.3)	5.8 (0.8)	nd
Protein (%)	15.2-25.7	19.9 (2.0)	21.2 (2.2)	21.6 (2.6)	20.8 (2.3)	19.8 (1.5)	21.1 (0.3)	20.2 (1.1)
Starch (%)	33.1-47.8	42.8 (2.8)	40.9 (4.1)	40.4 (3.2)	41.3 (2.4)	40.7 (1.3)	40.9 (0.3)	40.6 (0.5)

*composition is on an "as is" basis; nd = not determined due to test not being performed for 10 years.

The mean **fat content** was 5.9% with a range from 4.8 to 7.1% (Table 34). Literature reports indicate that chickpeas have a fat content between 2 and 7%; therefore, the fat content of chickpeas grown in 2025 falls within the range reported by others but is higher than the fat content recorded in previous years. Fat content was slightly higher than the 5-year mean fat content of 5.8% (Table 34). The Palmer cultivar had the highest (6.3%) fat content among chickpeas (Table 35). Furthermore, the fat content of Dylan and Royal cultivars had the lowest (5.1%) fat among chickpeas.

Protein content of chickpeas ranged from 15.2 to 25.7%, with a mean of 19.9% (Table 34). The mean protein content of chickpea grown in 2025 was lower than the 5- and 10-year mean protein contents of 21.1 and 20.2%, respectively. Overall, the protein contents of Desi and Kabuli chickpeas were 19 and 20%, respectively. Dylan had the lowest (16.7%) mean protein content, while CDC Frontier had the highest mean protein content at 22.0% (Table 35).

Total starch content of chickpea ranged from 33.1 to 47.8%, with a mean of 42.8% (Table 34). The mean total starch content of chickpeas grown in 2025 was higher than the mean starch content observed in chickpeas from the previous harvest years and was slightly higher than the 5- and 10-year mean total starch content of 40.9 and 40.6%, respectively. The starch contents of Desi and Kabuli chickpeas were 41.4 and 42.9%, respectively. The Kasin cultivar had the lowest (41.1%) mean starch content, while the highest (44.3%) was observed in the Dylan cultivar.

Table 35. Mean proximate composition of Kabuli and Desi chickpea cultivars grown in the USA, 2025.

Cultivar	Concentration (%)* Moisture	Ash	Fat	Protein	Starch
Billy Bean	6.8	2.7	5.5	21.6	42.2
CDC Frontier	7.4	2.5	6.2	22.0	42.5
CDC Leader	9.1	2.6	6.0	19.9	41.7
CDC Orion	8.8	2.3	5.9	18.9	43.4
Dylan**	7.5	2.8	5.1	16.7	45.5
Kasin	8.8	2.6	5.7	20.6	41.1
Nash	7.7	2.6	5.8	20.2	44.3
Palmer	7.5	2.5	6.3	19.1	45.2
Quinn	7.3	2.6	5.7	20.4	42.4
Royal**	6.4	2.5	5.1	21.5	44.2
Sawyer	8.3	2.5	5.4	21.8	42.6
Sierra	7.3	2.6	6.1	19.5	42.6
Desi type#	7.9	2.6	5.6	19.0	41.4

*composition is on an "as is" basis; **Value from one sample of cultivar tested. #variety not provided.

Physical parameters of chickpeas (Tables 36-39)

Test weight, 1000-seed weight, water hydration capacity, percentage unhydrated seeds, swelling capacity, cooked firmness, and color represent the physical parameters used to define physical quality. The data presented also includes size distribution. Test weight ranged from 54.5 to 63.7 lbs./Bu with a mean of 58.1 lbs./Bu. This mean value is less than both the 5- and 10-year mean test weights (Table 36). The test weights of individual cultivars ranged from 54.6 lbs./Bu in Dylan to 60.6 lbs./Bu in the Billy Bean cultivars (Table 37). The range and mean 1000-seed weight of chickpeas grown in 2025 were 157-562 g and 425 g, respectively (Table 36). The mean 1000-seed weight was slightly lower than the 5- and 10-year mean values of 433 and 430 g, respectively. The mean 1000-seed weight for Desi and Kabuli chickpeas was 176 and 433 g, respectively. The Nash cultivar had the highest mean 1000-seed weight at 556 g, while the Billy Beans and Kasin cultivars had the lowest mean value at 302 g (Table 37). In 2023 and 2024, Nash also had the highest 1000-seed weight of 526 and 591 g, respective. Thus, supporting Nash as the largest chickpea in the last three years.

Table 36. Physical parameters of chickpeas grown in the USA, 2021-2025 plus 5- and 10-year mean values.

Physical Parameter	Year							
	2025		2024	2023	2022	2021	5-year	10-year
	Range	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Test Weight (lb/Bu)	54.5-63.7	58.1 (1.7)	57.8 (1.8)	60.6 (2.1)	61.2 (1.9)	61.2(1.8)	60.5 (1.6)	60.9 (1.2)
1000 Seed Wt	157-562	425 (84)	411 (77)	398 (77)	477 (50)	464 (67)	433 (35)	430 (26)
Water Hydration Capacity (%)	86-139	103 (7)	110 (8)	109 (9)	105 (7)	105 (9)	107 (2)	106 (3)
Unhydrated Seeds (%)	0-1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Swelling Capacity (%)	109-233	139 (16)	142 (13)	133 (15)	125 (12)	144 (20)	138 (9)	136 (7)
Cooked Firmness (N/g)	13.8-28.3	18.1 (2.5)	19 (3)	18.6 (2.9)	19.7 (2.3)	19.6 (2.9)	19.4 (0.7)	21.3 (3.1)
% of Sample Retained on 22/64 Sieve	0.0-95.9	60.8 (28.6)	62.1 (24.2)	53.8 (27.7)	79.5 (15.3)	69.0 (21.5)	64 (10.5)	nd
% of Sample Retained on 20/64 Sieve	0.5-58.4	24.3 (14.1)	26.6 (13.9)	29.9 (16.1)	16.7 (11.9)	22.8 (12.6)	26.0 (6.7)	nd
% of Sample Retained on 18/64 Sieve	0.3-60.0	10.6 (14.2)	9.4 (11.0)	11.9 (14.7)	3.6 (3.2)	7.1 (9.9)	8.3 (3.1)	nd
% of Sample Passed Through an 18/64 Sieve	0.0-80.0	4.3 (12.6)	1.9 (3.7)	4.5 (12.6)	0.3 (0.9)	1.1 (2.5)	1.6 (1.7)	nd

nd = not determined due to test not being performed for 10 years.

Water hydration capacity of chickpeas ranged from 86 to 139%, with a mean of 103% (Table 36). The water hydration capacity of chickpeas from 2025 was slightly lower than the 5- and 10-year mean values of 107 and 106%, respectively. Desi and Kabuli chickpeas had water hydration capacities of 93 and 103%, respectively. Differences in water hydration capacities were observed among cultivars. Among Kabuli chickpeas, the CDC Orion cultivar had the lowest water hydration capacity (100%) while CDC Leader had the highest (112%) (Table 37).

The **unhydrated seed percentage** was 0% for all chickpeas. The 0% unhydrated seeds matched the 5- and 10-year mean values of 0% (Table 36). All the cultivars had 0% unhydrated seed values (Table 37). No issues were observed with the rehydration of the chickpea samples. The **swelling capacity** of chickpeas ranged from 109 to 233%, with a mean value of 139% (Table 36). The mean swelling capacity value of chickpeas from 2025 was higher than the 5- and 10-year mean swelling capacity of 138 and 136%, respectively. Desi and Kabuli chickpeas had swelling capacities of 117 and 140%, respectively. The Billy Bean cultivar had the highest mean swelling capacity (157%) while the Sawyer cultivar had the lowest value (133%) among chickpeas (Table 37). The highest water hydration capacity for the Billy Bean cultivar may be the reason for the higher swelling capacity. Furthermore, Billy Beans also had the highest swelling capacity of chickpeas in 2024.

Table 37. Mean physical properties of chickpea cultivars grown in the USA, 2025.

Cultivar	Test Weight (lb/Bu)	1000 Seed Wt (g)	Water Hydration Capacity (%)	Unhydrated Seeds (%)	Swelling Capacity (%)	Cooked Firmness (N/g)	% of Sample Retained on 22/64 Sieve	% of Sample Retained on 20/64 Sieve	% of Sample Retained on 18/64 Sieve	% of Sample Passed Through an 18/64 Sieve
Billy Bean	60.6	302	111	0	157	18.6	3.9	44.7	42.3	9.2
CDC Frontier	59.2	359	107	0	139	19.6	31.8	48.1	17.2	3.0
CDC Leader	58.4	352	112	0	150	16.8	35.7	37.3	24.3	2.8
CDC Orion	57.8	406	100	0	136	18.9	63.5	28.0	6.6	1.9
Dylan*	54.6	545	105	0	149	19.0	93.1	6.2	0.7	0.0
Kasin	60.3	302	107	0	143	16.0	3.4	22.5	45.5	28.6
Nash	56.6	556	104	0	137	20.4	92.6	6.0	1.3	0.0
Palmer	59.5	394	104	0	135	18.9	58.3	32.7	7.3	1.6
Quinn	58.4	488	104	0	151	17.9	86.6	10.3	2.7	0.4
Royal*	59.2	474	109	0	147	21.4	78.2	17.6	4.1	0.1
Sawyer	59.6	436	101	0	133	16.6	57.8	33.3	8.1	0.9
Sierra	57.5	480	102	0	134	17.2	80.7	16.6	2.5	0.2
Desi type#	56.1	176	93	0	117	26.9	2.0	6.5	34.2	57.4

*Value from one sample of cultivar tested. #Variety not provided.

The **cooked firmness** of all chickpeas ranged from 13.8 to 28.3 N/g, with a mean value of 18.1 N/g (Table 36). The mean firmness value for chickpea in 2025 was lower than the 5- and 10-year mean values (19.4 and 21.3 N/g, respectively). This supports that chickpeas were slightly less firm after cooking compared to chickpeas from previous years and that the chickpea cooking using a standard time produced chickpeas with a tender structure. Desi and Kabuli chickpeas had cooked firmness values of 26.9 and 17.8 N/g, respectively. Among the cultivars, Kasin had the lowest cooked firmness (16.0 N/g) while the Royal (21.4 N/g) cultivar was the firmest (Table 37).

Retention of chickpea on a series of sieves was used to determine chickpea size. The mean retentions of 60.8, 24.3, 10.6, and 4.3% on the 22/64-, 20/64-, 18/ 64- and passed through the 18/64-inch sieves were observed in the 2025 chickpeas, respectively (Table 36). The range of retention on the largest screen (22/64-inch sieve) was from 0.0 to 95.9%. The percentage of retention of chickpeas on the two largest screens (22/64 and 20/64-inch sieves) was approximately 85.1% in 2025, while retention values of 89, 84, 96, and 92% were observed for the chickpea harvested in 2024, 2023, 2022, and 2021, respectively. This data shows that more samples of cultivars with smaller seeds were evaluated in 2025. Desi and Kabuli chickpeas had retention on the 22/64-inch sieve values of 2.0 and 62.6 %, respectively. The highest percentage retention (93.1%) of the chickpea sample on the 22/64-inch sieve was observed for the Dylan cultivar followed by Nash (92.6%). The lowest (3.4%) retention on the 22/64-inch sieve was observed in the Kasin cultivar (Table 37).

Color quality was measured using L*, a*, and b* values, and from these values, a color difference was determined on chickpeas before and after soaking (Table 38). **Color quality** indicated that the lightness (i.e., L*) of the chickpeas from 2025 was lower than that of chickpeas grown in prior years, and the chickpea that made up the 5-year mean L* values (Table 38). In contrast, the L* value for chickpeas grown in 2025 was higher than the 10-year mean L* value. In 2025, the a* value of 6.14 was the same as the a* value of chickpea from 2023. Furthermore, the a* value for the chickpea from 2025 was comparable to the 5-year a* values of 6.17 but lower than the a* value (7.06) for chickpeas that made up the 10-year mean value. This indicates that the chickpea had less redness compared to the long-term (10 years) average. The b* value for chickpeas from 2025 indicated similar yellowness to the chickpeas from 2022-2023. However, the 2025 chickpeas on average had less yellowness compared to chickpea samples that were used to determine the 5- and 10-year mean yellowness (i.e., b*) (Table 38). The color of the chickpeas changed after the soaking process. Soaked chickpeas had similar lightness values, as evidenced by the similar L* values (Table 38) compared to pre-soaked chickpeas. This same trend occurred in samples from 2022 and 2023 and for samples that made up the 5- and 10-year mean L* values. The redness (i.e., a* value) did change slightly after soaking. Chickpeas from all years became more yellow (i.e., increased b* value) after soaking. The color difference between the pre- and post-soaked chickpea from 2025 was most similar to the color difference for samples from 2024 but higher than in chickpea from 2023 and lower than in chickpea that were used in the determination of the 10-year mean b* value (Table 38).

Table 38. Physical parameters of Kabuli chickpeas grown in the USA, 2022-2025 plus 5- and 10-year mean values.

Color Scale*	Mean (SD) Color Values					
	Before Soaking				5-Year	10-Year
	2025	2024	2023	2022	Mean	Mean
L* (lightness)	59.16 (2.63)	60.12 (1.87)	59.21 (1.59)	60.57 (1.17)	60.34 (0.77)	58.57 (4.28)
a* (red-green)	6.14 (0.61)	6.34 (0.67)	6.14 (0.63)	6.01 (0.51)	6.17 (0.15)	7.06 (1.44)
b* (yellow-blue)	14.48 (1.41)	14.80 (0.88)	14.64 (1.27)	14.48 (0.67)	14.76 (0.44)	17.11 (4.04)
Color Scale*	**After Soaking**				**5-Year**	**10-Year**
	2025	**2024**	**2023**	**2022**	**Mean**	**Mean**
L* (lightness)	59.70 (2.90)	58.82 (2.00)	59.68 (1.13)	60.96 (1.12)	60.53 (1.24)	59.86 (4.31)
a* (red-green)	7.00 (1.04)	6.62 (0.62)	6.52 (0.48)	6.77 (0.46)	6.60 (0.14)	7.88 (2.35)
b* (yellow-blue)	25.22 (2.50)	24.79 (2.94)	25.24 (3.52)	24.40 (1.27)	25.00 (0.53)	27.69 (5.81)
Color Difference	10.94 (1.39)	10.80 (3.26)	9.85 (1.10)	11.23 (3.35)	10.58 (0.62)	12.28 (4.99)

red, negative values are green, and zero is neutral; and b* (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. Color difference is the change in color after soaking.

Table 39. Mean color quality of chickpea cultivars grown in the USA, 2025.

Cultivar	Mean Color Values*						
	Before Soaking			After Soaking			Color
	L	a	b	L	a	b	Difference
Billy Bean	57.94	7.12	15.19	60.17	7.64	28.75	13.77
CDC Frontier	58.82	6.16	14.73	60.15	7.14	27.25	12.64
CDC Leader	58.77	6.38	14.88	60.42	7.23	26.77	12.07
CDC Orion	58.82	6.47	15.54	60.07	7.06	26.12	10.70
Dylan**	63.06	4.72	12.77	61.24	6.52	24.30	11.82
Kasin	58.26	7.17	15.89	60.96	7.30	28.29	12.71
Nash	59.98	5.61	13.80	60.06	6.93	25.33	11.63
Palmer	59.50	6.77	15.64	60.94	7.19	27.19	11.65
Quinn	58.29	5.77	13.51	58.80	7.35	24.58	11.21
Royal**	60.30	5.94	14.32	60.34	7.10	26.18	11.92
Sawyer	59.40	6.07	15.13	60.75	6.33	24.93	9.97
Sierra	60.70	5.66	14.09	60.04	6.52	24.50	10.48
Desi type#	46.44	7.16	7.77	43.65	12.20	13.47	8.24

*color scale: L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. **Only one sample of cultivar tested. **Value from one sample of cultivar tested. #Variety not provided.

Among cultivars, Dylan had the highest L* value (63.06) while Billy Bean had the lowest (i.e., 57.94). However, Desi chickpea had the lowest L* at 46.44. The Dylan cultivar had the lowest a* value (4.72) among cultivars, while Kasin had the highest (7.17). The highest yellowness value (i.e., b*) was observed in Kasin (Table 39), while Dylan had the lowest b* value of 12.77. Visual observations support the color value differences as the Dylan cultivar appeared cream in color and less yellow than other cultivars. Except for a few cultivars, lightness increased during soaking, as evidenced by the higher L* value of the soaked samples. An increased redness and yellowness (increased a* and b* values, respectively) was observed for all cultivars. The greatest color difference was observed in the Billy Bean cultivar (Table 39), while the Sawyer cultivar had the least color change among Kabuli chickpeas. Overall, Desi chickpeas underwent the least color (8.24) among all chickpeas. The change in color observed in the samples was likely due to the significant increase in yellowness (a change in b* values) during the soaking. The color change is supported by visual observations, where the chickpea appeared more yellow after soaking.

Pasting properties (Tables 40-41)

Large variability in peak (71-166 RVU), hot paste (69-155 RVU) and cold paste (89-232 RVU) viscosities were observed in the 2025 chickpea crop. Peak, hot paste, and cold paste viscosities of chickpeas grown in 2025 were comparable the 5- and 10-year mean peak, hot paste, and cold paste viscosities (Table 40). The peak time was longer for samples from 2025 compared to other crop years, including the 5- and 10-year mean peak time value. This indicates that starch gelatinization requires additional heating time to form a paste compared to samples from previous years. Peak, hot paste, and cold paste viscosities of Desi chickpeas were 95, 92, and 120 RVU compared to 128, 124, and 182 RVU, respectively for Kabuli chickpeas.

For Kabuli chickpea, Kasin had the lowest peak viscosity (115 RVU) while Royal (148 RVU) had the highest peak viscosity (Table 41). The Kasin and Royal cultivars also had the lowest (111 RVU) and highest (144 RVU) hot paste viscosity. Kasin and Royal cultivars also had the lowest (154 RVU) and highest (214 RVU) cold paste viscosities, respectively (Table 41). Pasting temperature was lowest (76.3 °C) and highest (78.6 °C) for Palmer and Billy Beans cultivars, respectively.

The RVA gel firmness ranged from 63 to 307 g with a mean of 216 g (Table 40). Desi and Kabuli chickpea types had RVA gel firmness values of 121 and 219 g, respectively. Variability in gel firmness was also observed among cultivars. The Royal cultivar had the firmest (i.e., highest value) RVA gel firmness (306 g) while CDC Frontier (153 g) produced a gel with the least firmness (Table 41). The gels formed from samples in 2025 were visually firmer compared to samples from 2024.

Table 40. Starch characteristics of Kabuli chickpeas grown in the USA, 2021-2025 plus 5- and 10 year mean values.

Starch Characteristic	Year 2025 Range	2025 Mean (SD)	2024 Mean (SD)	2023 Mean (SD)	2022 Mean (SD)	2021 Mean (SD)	5-year Mean (SD)	10-year Mean (SD)
Peak Viscosity (RVU)	71-166	127 (14)	116 (30)	122 (20)	125 (14)	129 (20)	126 (7)	129 (7)
Hot Paste Viscosity (RVU)	69-155	123 (14)	106 (23)	116 (19)	121 (12)	123 (18)	119 (8)	124 (8)
Breakdown (RVU)	1-17	4 (3)	10 (13)	6 (5)	4 (4)	10 (1)	8 (3)	6 (2)
Cold Paste Viscosity (RVU	89-232	181 (24)	124 (39)	154 (33)	189 (28)	200 (53)	171 (31)	183 (26)
Setback (RVU)	20-89	58 (14)	22 (13)	37 (16)	68 (17)	77 (36)	52 (23)	60 (18)
Peak Time (Minute)	4.67-7.00	6.60 (0.58)	6.46 (0.68)	6.59 (0.50)	6.53 (0.58)	6.47 (0.63)	6.43 (0.18)	6.29 (0.22)
Pasting Temperature (°C)	73.4-80.0	76.8 (1.6)	78.7 (2.1)	78.2 (3.4)	77.1 (1.4)	76.9 (1.2)	77.8 (0.8)	76.6 (1.4)
RVA Gel Firmness (g)	63-307	216 (59)	116 (47)	159 (37)	272 (54)	*	nd	nd

*not previously measured; nd = not determined due to test not being performed for 5 or 10 years.

Table 41. Mean starch characteristics of chickpea cultivars grown in the USA, 2025.

Cultivar	Peak Viscosity (RVU)	Hot Paste Viscosity (RVU)	Breakdown (RVU)	Cold Paste Viscosity (RVU)	Setback (RVU)	Peak Time (Min)	Pasting Temperature (°C)	RVA Gel Firmness (g)
Billy Bean	129	126	3	174	48	7.00	78.6	203
CDC Frontier	133	126	7	178	52	6.42	77.8	153
CDC Leader	131	128	2	183	54	6.64	76.9	215
CDC Orion	131	125	6	180	55	6.24	76.5	184
Dylan*	118	116	2	177	61	6.13	76.8	268
Kasin	115	111	4	154	43	6.58	77.3	168
Nash	128	126	2	188	61	6.51	76.7	270
Palmer	133	129	4	184	55	6.80	76.3	191
Quinn	119	118	1	173	55	6.86	76.5	229
Royal*	148	144	4	214	70	6.13	76.8	306
Sawyer	123	119	4	177	58	6.48	77.3	183
Sierra	125	123	2	186	63	6.80	76.5	252
Desi type#	95	92	3	120	28	6.87	77.9	121

*Value from one sample of cultivar tested. #Variety not provided.

Functional properties (Tables 42-43)

Functionality property evaluation was new in 2022. Thus, only 3 years of data exist on emulsion activity and stability, foaming capacity and stability, water holding capacity, and oil holding capacity. Emulsion activity and stability for all chickpea samples ranged from 51 to 58% and 51 to 57% (Table 42). Slight differences in emulsion activity and stability were observed between the samples from 2025 and the previous years. Furthermore, consistent results were observed among cultivars (Table 43). In contrast to emulsion activity, foaming capacity varied to a greater extent (97-153%).

Table 42. Functional properties of chickpeas grown in the USA, 2022-2025.

Starch Characteristic	Year 2025 Range	2025 Mean (SD)	2024 Mean (SD)	2023 Mean (SD)	2022 Mean (SD)
Emulsion Activity (%)	51-58	54 (1)	56 (1)	55 (1)	57 (1)
Emulsion Stability (%)	51-57	54 (1)	55 (1)	56 (1)	58 (1)
Foaming Capacity (%)	97-153	118 (12)	127 (20)	169 (29)	164 (20)
Foam Stability (%)	79-108	88 (5)	83 (9)	86 (8)	85 (5)
Water Holding Capacity (g/g)	0.53-1.13	0.98 (0.09)	1.35 (0.23)	1.10 (0.20)	1.01 (0.11)
Oil Holding Capacity (g/g)	0.15-0.40	0.25 (0.05)	0.26 (0.07)	0.20 (0.07)	0.25 (0.09)

Table 43. Functional properties of chickpea cultivars grown in the USA, 2025.

Cultivar	Emulsion Activity (%)	Emulsion Stability (%)	Foaming Capacity (%)	Foam Stability (%)	Water Holding Capacity (g/g)	Oil Holding Capacity (g/g)
Billy Bean	55	54	121	87	1.04	0.28
CDC Frontier	54	54	120	84	0.97	0.26
CDC Leader	54	54	122	84	1.05	0.22
CDC Orion	54	54	126	89	1.01	0.21
Dylan*	54	56	107	87	1.00	0.29
Kasin	54	55	117	89	0.97	0.25
Nash	55	55	119	85	1.01	0.23
Palmer	52	52	123	85	1.02	0.19
Quinn	54	53	129	87	1.00	0.26
Royal*	57	55	110	88	0.92	0.25
Sawyer	54	54	123	87	0.94	0.25
Sierra	55	55	112	88	0.94	0.27
Desi type#	53	55	125	87	1.1	0.25

*Value from one sample of cultivar tested. #Variety not provided.

The mean foaming capacity in samples from 2025 was significantly lower than the foaming capacities from 2022 and 2023. However, the mean foaming stability observed in 2025 was slightly higher than the foaming stability in chickpeas from 2022-2024. Differences in foaming capacity among different cultivars of chickpeas were observed (Table 43). Quinn had a mean foaming capacity of approximately 129%. In contrast, Dylan had the lowest foaming capacity at 107%. Foam produced by CDC Orion and Kasin had the highest stability (89%). In contrast, CDC Frontier and CDC Leader produced foams with slightly lower foam stability than other cultivars. Lower mean water holding capacity was observed in chickpeas from 2025 compared to chickpeas from prior years. CDC Leader had the highest water holding capacities compared to other cultivars, while Royal had the lowest water holding capacity. Minimal differences in the oil holding capacities were observed in the chickpeas from 2025 compared to chickpeas from prior years. The cultivars Dylan and Palmer had the highest and lowest oil holding capacities, respectively.

Canning Quality Results

Canning quality was completed only on peas and chickpeas. The quality evaluation includes hydration capacity, swelling capacity, canned firmness, and color evaluation. Hydration capacity and swelling capacity were determined following the soak test method. The only difference was that the hydration and swelling capacity were measured on a canned pea or chickpea.

Peas (Tables 44-46)

The mean **water hydration capacity** of canned peas was 200% for all peas (Table 44). This value is lower than the water hydration capacity of peas from the recent crop years except 2021. The water hydration capacity of the pea from 2025 is similar to the 5-year mean water hydration value. Water hydration capacities ranged from 140 to 277% for all peas in 2025. A difference in water hydration capacity between the green (186%), yellow (214%), and winter (194%) peas was observed (Table 44). Overall, the data for the green and yellow peas indicates similar water uptake of the peas from 2025 compared to the 5-year mean water hydration capacities of their respective classes. In winter peas, peas from 2025 had lower water uptake than the peas that made up the 5-year mean water hydration capacity. The **swelling capacity** is the amount of swelling that occurs during the rehydration of the dry pea and the canning operation. The swelling capacity of all peas ranged from 163 to 237%, with a mean value of 201% (Table 44). These values matched the swelling capacity of peas from the 2023 and 2024 crop years but were slightly higher than the 5-year mean value. Green and yellow peas had similar swelling capacities (198 and 203%, respectively) while winter peas had slightly higher (203%) mean swelling capacity. All classes of peas from 2025 had swelling capacities that were higher than their respective 5-year mean swelling capacities.

Table 44. Mean physical parameters of canned dry pea grown in 2021-2025 plus the 5-year mean value.

Physical Parameter	2025		Mean (SD)				
	Range	Mean (SD)	2024	2023	2022	2021	5-year
All Pea Samples							
Water Hydration Capacity (%)	140-277	200 (30)	208 (31)	210 (37)	231 (24)	143 (28)	198 (33)
Swelling Capacity (%)	163-237	201 (14)	199 (26)	200 (24)	165 (18)	181 (12)	190 (17)
Canned Firmness (N/g)	2.7-14.7	6.3 (2.5)	6.3 (2.6)	9.1 (5.2)	5.8 (2.0)	17.8 (7.6)	9.3 (4.9)
Green Pea Samples							
Water Hydration Capacity (%)	140-268	186 (27)	198 (19)	206 (27)	221 (20)	137 (21)	192 (32)
Swelling Capacity (%)	163-228	198 (13)	193 (28)	189 (16)	156 (14)	180 (11)	184 (18)
Canned Firmness (N/g)	3.4-14.7	7.3 (2.6)	6.8 (2.1)	9.2 (3.7)	6.6 (1.0)	19.0 (6.7)	9.8 (5.3)
Yellow Pea Samples							
Water Hydration Capacity (%)	165-277	214 (29)	212 (35)	206 (42)	219 (30)	162 (29)	200 (22)
Swelling Capacity (%)	176-237	203 (14)	200 (26)	210 (25)	152 (17)	182 (14)	190 (24)
Canned Firmness (N/g)	2.7-11.4	5.3 (2.0)	6.0 (2.9)	9.7 (6.8)	7.4 (1.9)	12.6 (6.7)	8.6 (2.6)
Winter Pea Samples							
Water Hydration Capacity (%)	188-210	194 (11)	223 (29)	236 (46)	248 (7)	123 (8)	209 (50)
Swelling Capacity (%)	198-220	210 (11)	204 (21)	210 (30)	181 (5)	180 (12)	197 (15)
Canned Firmness (N/g)	5.1-8.2	6.4 (1.4)	6.5 (2.4)	7.1 (4.3)	3.9 (0.4)	23.7 (3.6)	9.7 (7.9)

Table 45. Mean color characteristics of canned dry pea grown in 2021-2025 plus the 5-year mean value.

	Mean (SD) Color Values*						
	Before Canning			After Canning			Color
Sample**	L	a	b	L	a	b	Difference
Green Pea Samples							
2025	58.33 (1.76)	-1.03 (0.84)	9.82 (0.94)	50.30 (1.66)	1.07 (0.86)	15.89 (1.09)	10.45 (1.07)
2024	58.35 (1.43)	-2.13 (0.60)	9.81 (0.63)	50.19 (1.32)	-0.24 (0.85)	16.38 (1.45)	10.88 (1.55)
2023	55.85 (3.12)	-2.01 (0.18)	10.23 (2.57)	48.21 (2.65)	0.37 (1.19)	19.20 (7.03)	12.85 (3.20)
2022	58.25 (2.03)	-2.08 (0.52)	10.11 (0.65)	50.05 (1.41)	0.13 (1.05)	18.92 (1.43)	12.51 (1.33)
2021	57.33 (2.35)	-2.30 (1.01)	10.45 (0.74)	48.03 (1.38)	0.32 (0.41)	14.50 (1.26)	10.67 (1.67)
5-Year Mean	57.68 (1.13)	-2.08 (0.16)	10.01 (0,39)	49.62 (1.50)	0.05 (0.33)	17.72 (2.20)	11.96 (1.09)
Yellow Pea Samples							
2025	62.09 (2.61)	4.81 (0.63)	14.76 (0.85)	54.90 (1.69)	4.79 (0.86)	20.73 (1.56)	10.11 (2.16)
2024	63.17 (1.27)	4.61 (0.59)	14.88 (1.00)	56.43 (1.99)	4.94 (1.03)	23.13 (1.86)	11.30 (1.20)
2023	61.76 (2.81)	5.24 (1.03)	14.79 (2.17)	55.07 (2.35)	5.34 (1.41)	23.44 (5.45)	11.87 (1.74)
2022	63.65 (1.20)	4.91 (0.90)	15.62 (0.43)	55.03 (2.62)	4.97 (1.42)	22.97 (3.03)	12.10 (1.07)
2021	64.29 (1.26)	5.30 (0.39)	15.04 (0.78)	55.91 (1.54)	7.04 (0.98)	23.14 (1.44)	11.95 (1.09)
5-Year Mean	63.27 (0.94)	5.01 (0.28)	14.98 (0.70)	55.78 (0.70)	5.29 (1.07)	23.43 (0.61)	12.06 (0.65)
Green Winter Pea Samples#							
2025	52.67 (0.00)	-3.07 (0.00)	8.75 (0.00)	47.79 (0.00)	-0.69 (0.00)	15.73 (0.00)	8.70 (0.00)
2024	59.57 (0.47)	-3.50 (1.92)	13.67 (0.29)	54.10 (8.00)	2.31 (3.26)	20.71 (6.82)	11.49 (0.25)
2023	53.45 (3.00)	-0.80 (0.96)	8.43 (0.64)	49.98 (1.66)	-0.59 (0.44)	18.29 (1.11)	10.59 (0.87)
2021	53.88 (0.34)	-2.54 (0.23)	8.49 (0.51)	45.06 (1.12)	0.24 (0.23)	12.99 (0.62)	10.35 (1.39)
2020	55.31 (1.11)	-1.84 (0.61)	8.93 (0.67)	51.10 (0.31)	-2.89 (0.19)	21.77 (1.30)	13.56 (0.92)
5-Year Mean	54.31 (3.68)	-2.19 (0.99)	9.12 (2.77)	48.95 (4.09)	-1.29 (1.29)	17.07 (4.58)	10.69 (2.20)
Yellow Winter Pea Samples							
2025	60.61 (2.61)	3.12 (0.63)	14.51 (0.85)	53.05 (1.69)	4.38 (0.86)	19.97 (1.56)	9.66 (2.16)
2024	58.64 (3.89)	0.89 (2.59)	12.75 (2.73)	52.20 (4.45)	2.72 (0.20)	20.27 (3.90)	13.13 (1.29)
2023	59.77 (0.31)	3.55 (0.77)	14.48 (1.06)	54.90 (1.05)	5.12 (0.35)	23.81 (2.03)	10.80 (0.87)
2022	60.28 (0.58)	2.01 (0.57)	13.36 (0.44)	56.32 (0.53)	2.81 (0.67)	24.32 (1.44)	11.77 (1.33)
2021	59.71 (3.01)	1.96 (1.87)	13.91 (0.88)	51.37 (0.25)	3.43 (0.81)	19.58 (0.16)	10.67 (1.43)
5-Year Mean	62.36 (2.28)	4.27 (1.89)	14.55 (1.08)	54.93 (1.64)	4.84 (1.59)	22.86 (1.56)	12.43 (0.63)

color scale: L (lightness) axis – 0 is black and 100 is white; a* (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b* (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. **Includes all pea samples or separated into market class. #Canning quality not determined on winter pea in 2022 as no sample of green winter was available; thus, no 5 year mean was calculated using samples from 2019-21 and 2023-2024. nd =not determined since data was not collected for the last 5 years prior to 2024.

The color of the dry pea changed after the canning process. The color difference fell between 8.70 and 10.45 for all peas, with green winter peas having the lowest color difference values (Table 45). All mean color differences for the green and yellow classes were lower than their respective 5-year mean color differences (Table 45). The lightness decreased during canning for all classes. This indicates that the samples became darker after canning, which is the same general trend for that happened in samples from previous years. The green and winter green peas tended to become less green and more yellow during canning, as evidenced by the increase in a* and b* values, respectively. The yellow peas and yellow winter peas became darker and yellower after canning.

Variability in hydration capacity, swelling capacities, and color was observed among the pea cultivars. In green peas, mean water hydration capacity ranged from 178% (Banner) to 209%

(Hampton) (Table 46). In yellow cultivars, AAC Chrome had the highest (246%) mean water hydration capacity, while the Iconic cultivar had the lowest (196%) value (Table 46). The winter pea cultivar Vail had the highest water hydration capacity (210%) compared to other winter peas. The green pea cultivars Ultra and Ariel had the highest (213%) and lowest (184%) mean swelling capacities, respectively. In yellow cultivars, AAC Ironhorse had the highest (215%) swelling capacity, while the Iconic cultivar had the lowest swelling capacity at 180% (Table 45). AAC Ironhorse also had the highest swelling capacity in 2024. The winter pea cultivars Blaze and Vail had the highest (220%) and lowest (179%) mean swelling capacities, respectively. Overall, the changes in color followed the same trends regardless of the cultivar. For example, the samples after canning were darker but had higher yellowness values. The color difference in canned peas varied from 6.50 in Iconic to 11.65 in Ariel (Table 46).

As expected, the **canned firmness** values of peas were significantly lower than the cooked firmness values of soaked peas in 2025. For comparison, the mean cooked firmness for all peas from 2025 was 21.3 N/g (Table 7), while for canned pea the mean firmness value was 6.3 N/g (Table 44). This observation is typical of what is expected and demonstrates the typical behavior of peas from 2025. The mean canned firmness of the peas from 2025 most closely matched the mean canned firmness of peas from 2024. The mean canned firmness of peas from 2025 was lower than that of the 5-year mean canned firmness value (Table 44). In general, the peas from different classes had canned firmness values that ranged from 5.3 N/g in yellow peas to 7.3 N/g in green peas. For all peas, the mean firmness values were lower than the values for their respective 5-year mean values. The Hampton cultivar was the least firm (4.0 N/g) among the green peas, while Passion (9.1 N/g) was the firmest (Table 46). Iconic had the lowest (3.4 N/g) firmness while CDC Inca was the firmest (8.8 N/g) among yellow cultivars. In winter peas, Winterberry had the least firmness (5.5 N/g) while Vail had the highest firmness (6.7 N/g).

Table 46. Mean physical and color parameters of canned dry pea cultivars grown in 2025.

Class	Cultivar	Hydration Capacity (%)	Swelling Capacity (%)	Canned Firmness (N/g)	Mean Color Values* Before Soaking L*	a*	b*	After Soaking L*	a*	b*	Difference
Green	Arcadia	179	190	7.6	58.27	-0.93	10.13	50.21	1.21	15.63	10.29
	Ariel**	183	184	7.7	58.25	-2.18	8.33	49.24	0.02	15.37	11.65
	Banner	178	202	8.7	54.34	-1.26	10.13	47.93	0.38	14.73	8.16
	Hampton**	209	201	4.0	58.73	-1.00	9.77	52.25	0.72	17.72	10.40
	Passion	189	207	9.1	57.64	-1.86	9.65	48.24	0.38	15.24	11.38
	PG Greenback	187	197	8.2	60.67	-0.27	10.37	51.19	2.04	16.01	11.37
	Ultra**	180	213	8.3	55.46	-2.43	9.72	47.59	0.41	15.70	10.33
Yellow	AAC Chrome**	246	200	4.2	62.57	5.36	15.68	54.95	5.36	20.05	9.27
	AAC IronHorse	243	215	3.5	61.43	4.20	14.26	56.82	4.13	22.22	9.35
	AAC Julius	217	190	3.7	61.54	5.84	16.03	55.88	4.91	20.76	7.51
	CDC Inca	202	194	8.8	62.67	5.25	14.74	53.84	4.78	19.05	9.90
	CDC Meadow	245	203	3.9	62.18	4.15	12.80	54.87	4.28	21.42	11.58
	Iconic**	196	180	3.4	61.01	5.70	15.70	56.22	5.70	20.03	6.50
	Treasure	213	192	4.2	62.64	4.46	14.24	56.36	5.38	21.95	10.09
Winter Green	Vail**	210	220	6.7	52.67	-3.07	8.75	47.79	-0.69	15.73	8.70
Winter Yellow	Blaze	189	212	6.6	59.72	1.99	14.54	52.22	4.30	19.24	9.29
	Winterberry**	190	198	5.5	62.38	5.37	14.43	54.72	4.56	21.43	10.41
Mottled/Maple	n/p**	185	213	9.1	46.98	4.16	7.59	40.14	6.69	7.81	7.32

*color scale: L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. **Only one sample of cultivar tested. n/p = information not provided with sample.

Chickpeas (Tables 47-48)

The mean **water hydration capacity** of canned chickpea was 172% with a range from 145 to 204%. The mean water hydration value of chickpeas in 2025 was significantly higher than the 5-year mean (163%) water hydration capacity (Table 47). Kabuli and desi chickpeas had water hydration capacities of 172 and 167%, respectively. This supports that under canning conditions both types of chickpeas absorb water similarly. The Dylan cultivar had the highest water hydration capacity at 202% while Sierra had the lowest at 164% (Table 48). Sierra also had the lowest water hydration capacity in 2024. The **swelling capacity** is the amount of swelling that occurs during the rehydration of the dry chickpea and the canning operation. The swelling capacity of all chickpeas ranged from 169 to 224%, with a mean value of 197%. Kabuli and desi chickpeas had swelling capacities of 198 and 173%, respectively. This data supports that under canning conditions Kabuli chickpeas tend to swell more than Desi chickpeas during the canning process even though they have similar water hydration capacities. CDC Leader and Dylan cultivars had the lowest swelling capacity at 190% while Billy Bean and Sawyer cultivars had the highest at 210% (Table 48).

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Table 47. Mean physical and color parameters of canned chickpea grown in 2021-2025 plus the 5-year mean value.

Year	Hydration Capacity (%)	Swelling Capacity (%)	Canned Firmness (N/g)	Mean (SD) Color Values* Before Soaking L	a	b	After Soaking L	a	b	Color Difference
2025	172 (13)	197 (12)	7.0 (1.5)	59.48 (2.65)	6.20 (0.65)	14.58 (1.36)	50.84 (2.96)	5.75 (0.56)	14.84 (2.25)	9.05 (2.62)
2024	165 (12)	181 (21)	6.7 (0.7)	60.02 (1.55)	6.39 (0.75)	15.12 (1.03)	53.24 (1.25)	5.70 (0.84)	16.20 (2.07)	7.36 (1.75)
2023	198 (15)	188 (16)	8.2 (2.1)	59.12 (1.59)	6.12 (0.60)	14.52 (1.18)	53.63 (1.08)	6.18 (0.61)	18.25 (1.15)	6.99 (1.39)
2022	163 (10)	124 (10)	6.6 (0.6)	61.36 (1.05)	6.16 (0.54)	14.77 (0.68)	53.88 (1.01)	5.53 (0.45)	17.68 (1.05)	8.24 (1.17)
2021	128 (9)	163 (13)	14.8 (1.4)	61.38 (1.11)	5.85 (0.56)	14.35 (0.69)	51.79 (0.80)	6.42 (0.53)	15.66 (0.90)	9.81 (1.17)
5-Year Mean	163 (25)	167 (25)	8.9 (3.4)	58.44 (4.63)	6.08 (0.22)	14.89 (0.52)	53.21 (0.82)	5.76 (0.56)	17.39 (1.46)	8.16 (1.10)
2025 (Data Range)	145-204	169-224	4.7-15.9	46.28-63.09	4.74-8.04	8.20-16.32	36.44-55.64	4.76-7.12	3.17-17.78	4.56-24.60

*color scale: L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral.

The **canned firmness** values of chickpeas were lower than the cooked firmness values of soaked chickpeas. The range in firmness was narrow (4.7-15.9) for samples from 2025. The mean canned firmness value of all chickpeas was 7.0 N/g (Table 47). In comparison, the mean cooked firmness for all chickpeas was 18.1 N/g (Table 36). As expected, the canned chickpeas were less firm than the cooked chickpeas. The mean firmness value for canned chickpeas in 2025 most closely matched the canned chickpeas from 2022 and 2024. The firmness of canned chickpeas in 2025 was lower than the chickpeas that made up the 5-year mean value. This indicates softer chickpeas on average for the canned chickpeas compared to the samples that made up the 5-year mean. Kabuli and desi chickpeas had canned firmness of 6.9 and 8.9 N/g, respectively and indicates similar firmness. Canned CDC Leader chickpeas had the highest firmness (9.0 N/g) while the Dylan chickpeas were the least firm (4.4 N/g) (Table 48).

Table 48. Mean physical and color parameters of canned dry chickpea cultivars grown in 2025.

Cultivar	Hydration Capacity (%)	Swelling Capacity (%)	Canned Firmness (N/g)	Mean Color Values* Before Soaking L	a	b	After Soaking L	a	b	Color Difference
Billy Bean	190	210	6.6	58.09	7.14	15.43	51.24	5.18	16.21	7.15
CDC Frontier	174	197	6.7	59.23	6.21	14.89	51.13	6.21	14.74	8.21
CDC Leader	170	190	9.0	59.42	6.60	15.28	47.41	5.63	11.80	12.91
CDC Orion	173	197	7.1	59.31	6.50	15.56	50.22	5.65	15.20	9.34
Dylan**	202	190	4.7	63.09	4.74	12.61	51.13	6.10	17.78	13.10
Kasin	167	211	8.5	58.46	7.11	16.03	51.17	5.86	14.83	7.57
Nash	174	197	6.6	60.13	5.60	13.77	50.13	5.53	15.06	10.14
Palmer	175	205	7.2	60.07	6.95	15.82	50.36	5.72	14.80	10.00
Quinn	181	200	7.1	58.37	5.82	13.22	49.01	5.95	14.77	9.61
Royal**	174	197	7.2	60.60	5.60	14.63	52.18	5.81	16.06	8.57
Sawyer	178	210	6.3	59.81	6.19	15.35	52.13	5.75	15.74	7.80
Sierra	164	191	6.6	60.93	5.70	14.14	52.42	5.90	15.20	8.64
Desi type#	167	173	8.9	46.47	7.65	8.49	43.57	5.42	8.02	9.31

*color scale: L (lightness) axis – 0 is black and 100 is white; a (red-green) axis – positive values are red, negative values are green, and zero is neutral; and b (yellow-blue) axis – positive values are yellow, negative values are blue, and zero is neutral. **Only one sample of cultivar tested.#Variety not provided for samples.

The color of the chickpeas changed after the canning process. The color difference fell between 4.56 and 24.60, with a mean value of 9.05 for all chickpeas (Table 47). The color difference for the canned chickpea in 2025 was higher than the canned chickpeas that made up the 5-year mean color difference value. Only samples from 2021 had higher color differences than the chickpeas from 2025. This supports more color changes for the canned samples compared to previous years, except 2021. A higher color difference was observed in soaked (10.94) chickpeas (Table 38) compared to canned (9.05) chickpeas (Table 47). This same trend was found in previous years and is likely attributed to the greater change in lightness and yellowness of soaked chickpeas. Furthermore, the L* or lightness decreased during canning (Table 47), which agrees with canned chickpeas from previous years. In contrast, the L* values of chickpeas increased in the soak test. The yellowness increased in canned chickpeas, which agrees with the trend of increasing yellowness after canning as observed in prior years. Unlike prior years, consistency in the change in yellowness was cultivar dependent where yellowness increased in some samples but not in others during canning. The highest color difference after canning was observed in the Dylan cultivar (13.10) while Billy Bean had the least (7.15) color change (Table 48). This trend was observed in 2024. The main reason for the observed color trends was that Dylan is a cream-colored chickpea, and after canning, it had a yellow brown color, which is measured by a substantial drop in L*, an increase in yellowness (b*) and redness (a*). In contrast, Billy Bean did not undergo significant change in L*, a* or b* and had a similar yellow brown color after canning compared to the dry sample.

Author

Dr. Clifford Hall, Professor, Pulse Quality, Dairy and Food Science, South Dakota State University, P.O. Box 2104, Brookings, SD, USA 56007.

Pulse Quality Technical Team

Graduate Students: **Chiranjivi Belbase, Monika Ghimire, Nolan Lee, Bednath Sharma**
Undergraduate lab researchers: **Gaayathri Janaswamy**

Funding Support

- Northern Pulse Growers Association
- U.S. Dry Pea and Lentil Council
- South Dakota State University Agriculture Experimental Station

Acknowledgements

The 2025 U.S. Pulse Quality team acknowledges support received from funding sources. Please direct questions, comments, suggestions, or requests for copies of this report to:

Dr. Clifford Hall (clifford.hall@sdstate.edu) at South Dakota State University

Ms. Shannon Berndt (berndt@northernpulse.com) at Northern Pulse Growers Association

Mr. Todd Scholz (tscholz@usapulses.org) at the USA Dry Pea and Lentil Council.