2024 Pulse Quality Evaluation

Dry Bean

Saskatchewan Food Industry Development Centre Inc.
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Pulse Quality Program—*Mission*

The Pulse Quality Program launched in spring 2022 with a partnership between Saskatchewan Pulse Growers and the Saskatchewan Food Industry Development Centre with the mission to add in best management practices for pulses grown in Western Canada and to help the development of pulse-based ingredients/products in the food industry.

The program aims to develop a comprehensive database of composition, functionality, and nutrition for pulses that provides information to growers, agronomists, breeders, buyers, and end users to make more informed choices. This program implements a genotype by environment (G x E) evaluation of quality parameters of peas, faba beans, lentils, chickpeas, and dry beans.

Phase 1 of the program analyzes up to 3000 samples annually from regional variety trials. The main focus of parameters includes seed quality (i.e., thousand kernel weight, amount of damage, seed size, and seed hardness), nutritional composition (i.e., ash, moisture, and protein content), milling, and colour. The generated data are compared across pulse varieties, locations, and years. Additional parameters will be considered in future years in Phase 2 and Phase 3.

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2024 Dry Bean Quality

A total of **75** dry bean samples harvested in **2024** were evaluated. There were **5** varieties, and three replicates of each variety were cultivated in each location. Samples were acquired from Melfort, Outlook (both wide and narrow trials), Redvers, and Saskatoon. Three replicates of each variety were cultivated in each location. **Table A** and **Figure A** provide the samples' information and locations in detail.

Figure B provides the cumulative rainfall during the 2024 growing season. Adequate rainfall in May improved topsoil moisture conditions across the province. However, subsequent moisture and cooler temperatures delayed seeding. Seeding progress has been fastest in the southwest and southeast, while the central and northeast regions have experienced slower progress due to higher spring snowfall accumulations. Provincially, seeding is nearly complete by the end of May. In June, cooler temperatures and excessive moisture further delayed overall crop development. By July and early August, reduced precipitation and rising temperatures depleted topsoil moisture reserves in many regions, accelerating crop advancement and maturity. The development of crops in the southern and western regions was further ahead while the central and northern regions fell behind. Harvest began in August and was completed in September, reflecting variable yields across the province.

Table A. Description of 2024 dry bean samples tested for the Pulse Quality Program.

Crop	Type	Variety	Site	Number of samples
Dry bean	Black	CDC Blackstrap	Melfort Outlook – Irrigation – Narrow row trial Outlook – Irrigation – Wide row trial Redvers Saskatoon	75
	Navy	AAC Shock CDC Whitetrack Blast		
	Yellow	CDC Sunburst		

Note:

- Four varieties that existed in 2022, 2023, and 2024 are shown in black.
- One variety presents in both 2023 and 2024, shown in blue.

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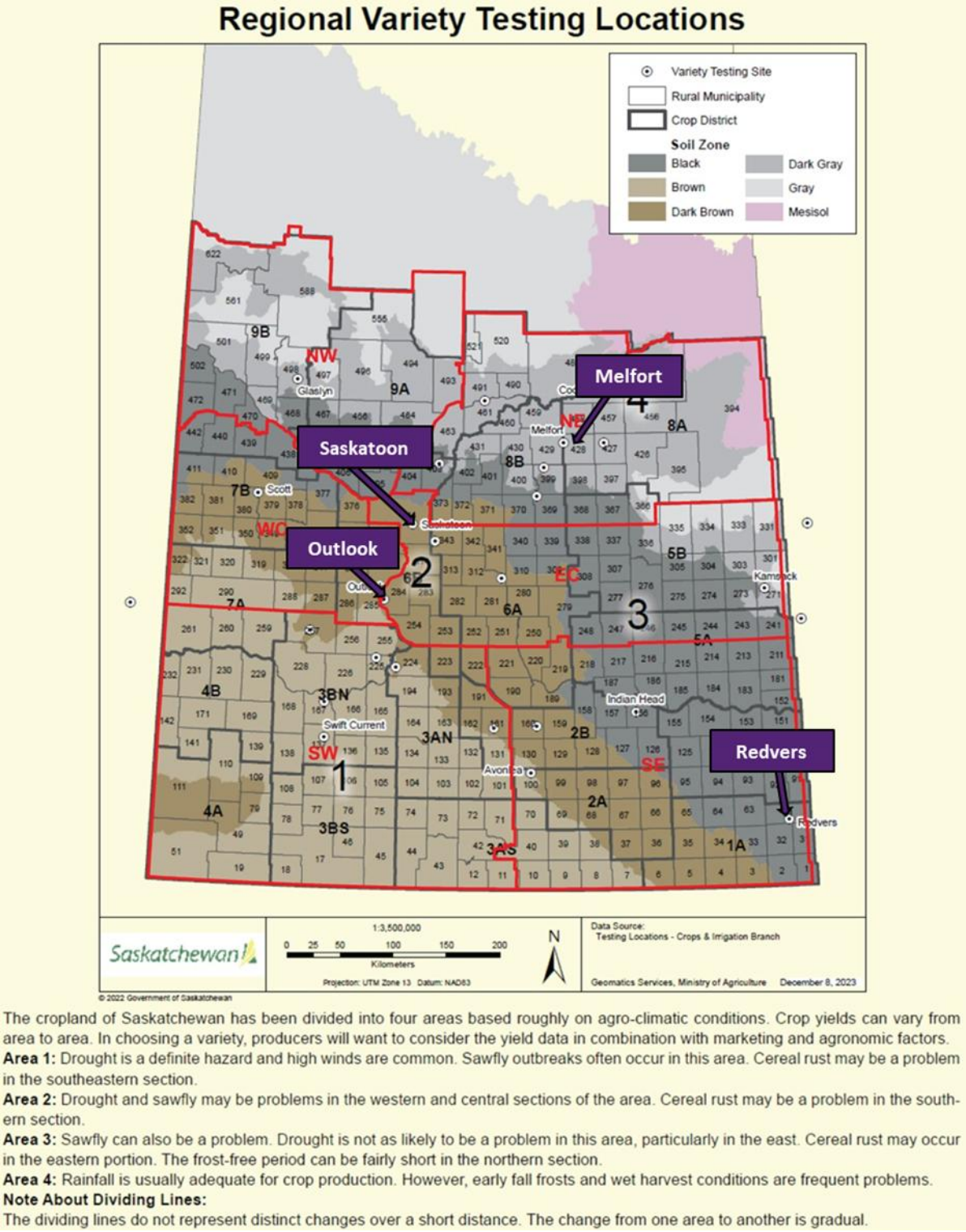

The cropland of Saskatchewan has been divided into four areas based roughly on agro-climatic conditions. Crop yields can vary from area to area. In choosing a variety, producers will want to consider the yield data in combination with marketing and agronomic factors.

Area 1: Drought is a definite hazard and high winds are common. Sawfly outbreaks often occur in this area. Cereal rust may be a problem in the southeastern section.

Area 2: Drought and sawfly may be problems in the western and central sections of the area. Cereal rust may be a problem in the southern section.

Area 3: Sawfly can also be a problem. Drought is not as likely to be a problem in this area, particularly in the east. Cereal rust may occur in the eastern portion. The frost-free period can be fairly short in the northern section.

Area 4: Rainfall is usually adequate for crop production. However, early fall frosts and wet harvest conditions are frequent problems.

Note About Dividing Lines:

The dividing lines do not represent distinct changes over a short distance. The change from one area to another is gradual.

Figure A. Locations for dry bean quality testing in 2024 and the corresponding soil zones. Figure was modified from material provided by the Saskatchewan Ministry of Agriculture.

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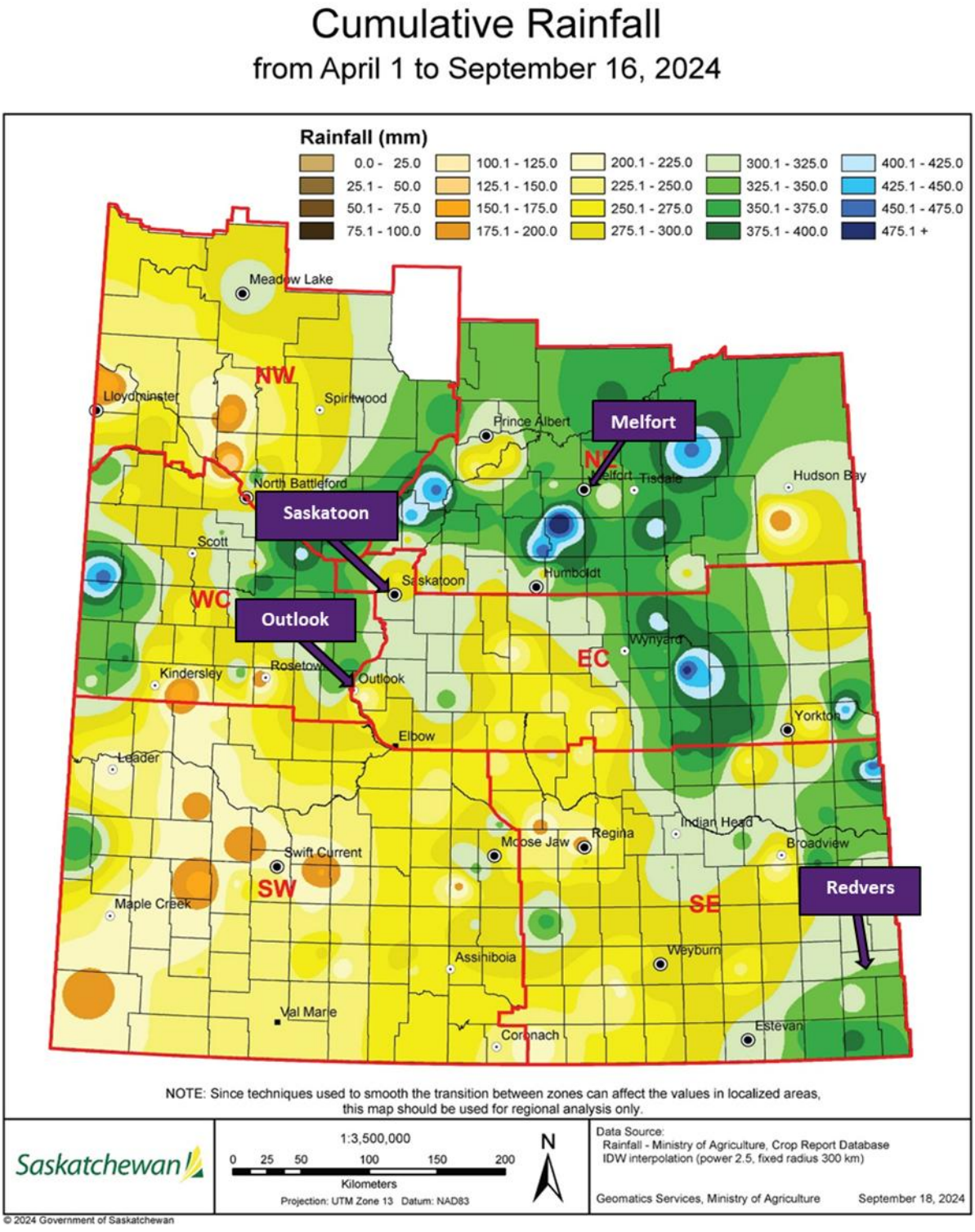

Figure B. Locations for dry bean quality testing and cumulative rainfall from April 1 to September 16, 2024. Figure was modified from material provided by the Saskatchewan Ministry of Agriculture.

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SASKATCHEWAN pulse Growers

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This report includes seven subsections for the results of the following quality parameters:

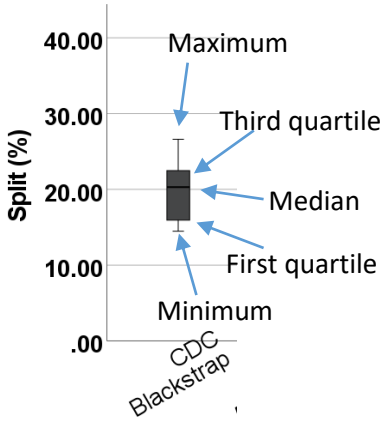
1. Yield
2. Thousand kernel weight (TKW)
3. Seed size: length, width, thickness
4. Hardness of whole seed
5. Ash content
6. Protein content
7. Protein productivity

The **method** used to evaluate each quality parameter is provided at the beginning of each subsection.

For the **results**, a **Box and Whisker** plot is first provided to show the full dataset of each variety, where the minimum, median, maximum, first quartile (the median of the lower half of the dataset), and third quartile (the median of the upper half of the dataset).

In addition, a **Bar** graph is included to provide the mean values by variety to show the variety performance and by location to show how the locations differed.

Furthermore, the effects of variety, location, and variety x location on the characteristic are given in a **table**.



For **statistics**, a one-way analysis of variance (ANOVA) along with a post-hoc Tukey test (SPSS, Chicago, IL, USA) was performed to identify the differences in the quality parameters, including yield, TKW, seed size, seed hardness, ash, protein, and protein productivity for each bean type by location and for navy bean by variety. A two-way analysis of variance (ANOVA) was conducted to determine the effects of variety, location, and their interaction on each parameter for navy beans.

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2024 Dry Bean Quality

1. Yield

Method: Yield refers to how much crops are produced and how efficiently land is used to produce food or agricultural commodities. The yield of each variety from each location is provided as kilogram per hectare (kg/HA).

Results: Figure 1.1. Box plot (left) and mean (right) of dry beans for yield by variety in 2024.

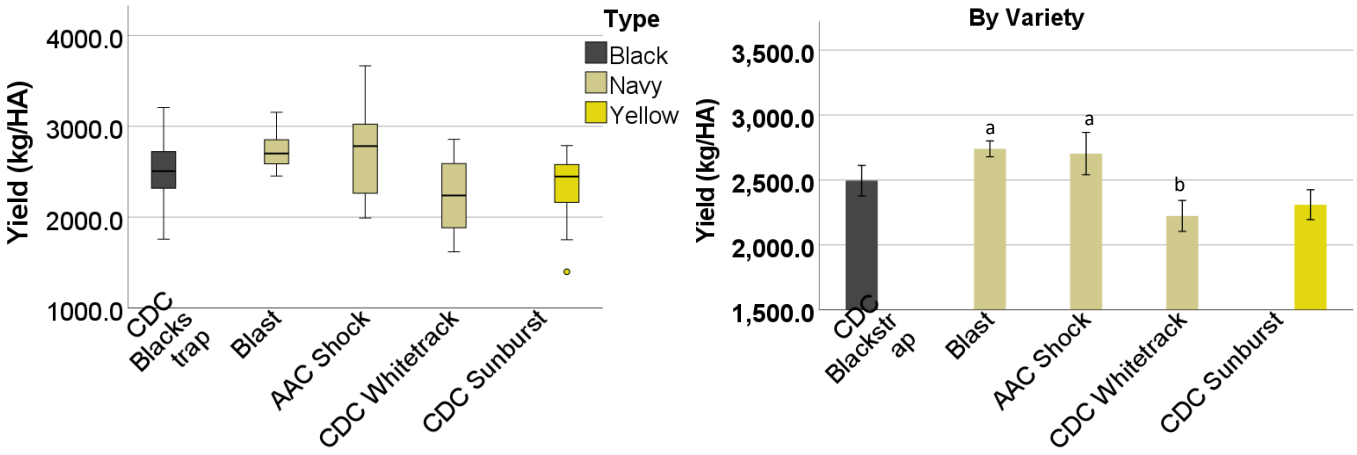

Figure 1.2. Mean yield of 2024 dry beans by location. Each bar represents mean ± one standard error.

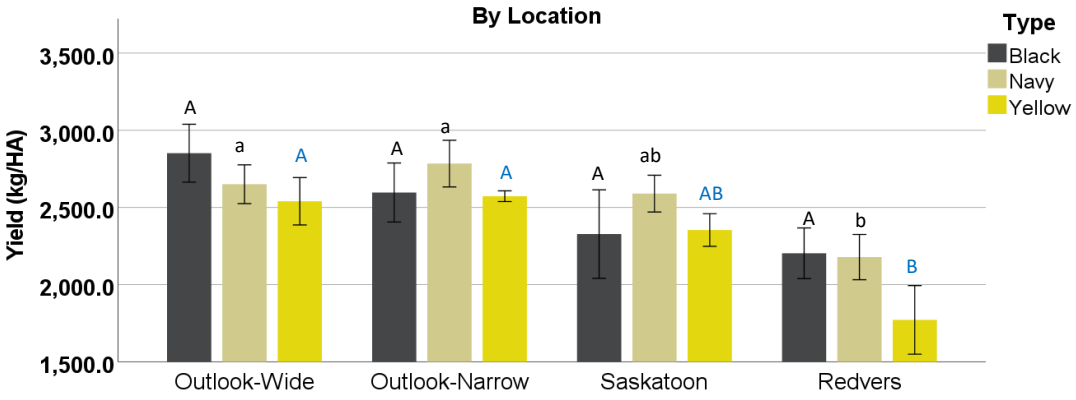

Table 1. Effects of variety and location.

	Navy
Variety	***
Location	**
Variety x Location	*NS*

*Note: ***p<0.001; **p<0.01; *p<0.05; NS not significant*

Note: Capital letters in black indicated significant differences (p<0.05) by black bean. Small letters in black indicated significant differences (p<0.05) by navy bean. Capital letters in blue indicated significant differences (p<0.05) by yellow bean.

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2. Thousand Kernel Weight

Method: Seed weight is an important parameter to indicate seed size and yield production. This test was conducted by weighing 300 seeds with duplicated measurements per sample, and the 1000 seed weight (TKW) was reported.

Results: Figure 2.1. Box plot (left) and mean (right) of dry beans for TKW by variety in 2024.

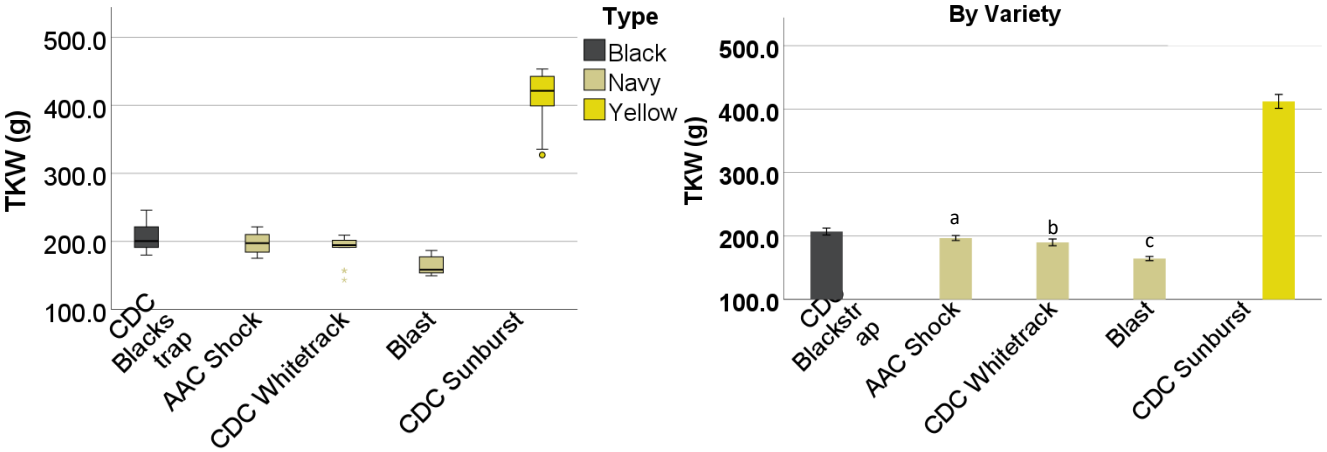
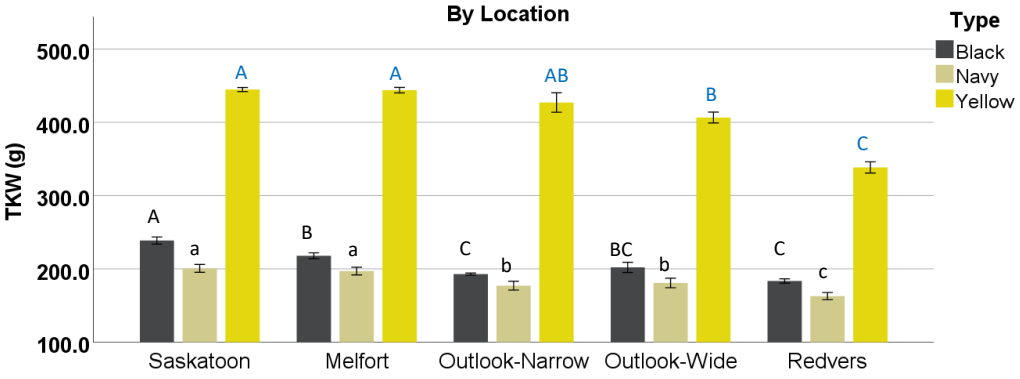


Figure 2.2. Mean TKW of 2024 dry beans by location. Each bar represents mean ± one standard error.



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	Navy
Variety	***
Location	***
Variety x Location	***

*Note: ***p<0.001; **p<0.01; *p<0.05; NS not significant*

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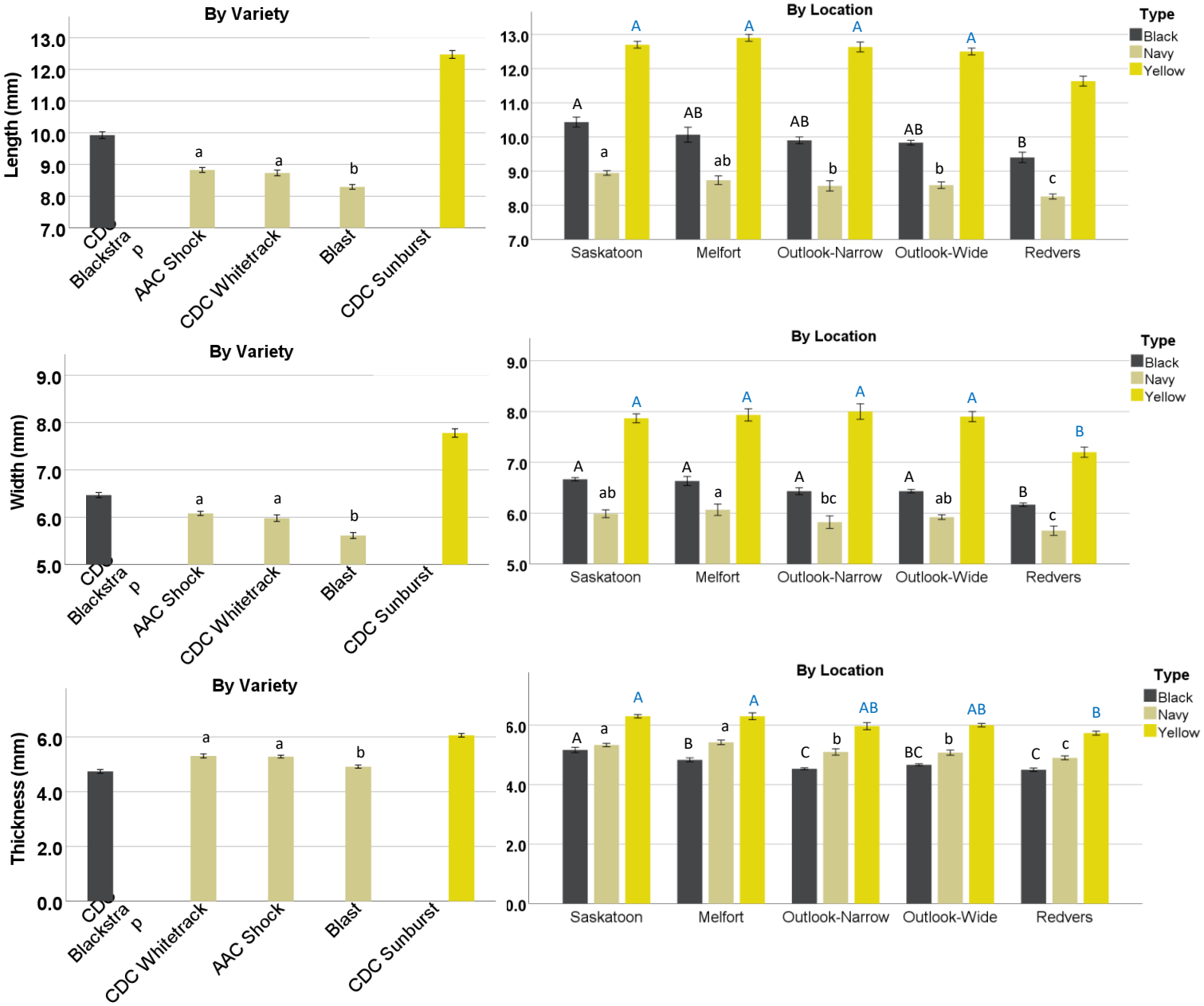
3. Seed Size

Method: The length, width, and thickness (mm) of the dry bean seed were measured with a caliper. The mean of twenty seeds was reported.

Figure 3.1. Mean of length (mm), width (mm), thickness (mm) of 2024 dry beans by variety (left) and by location (right). Each bar represents mean ± one standard error.



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4. Hardness of Whole Seed

Method: Seed hardness is an important parameter to indicate milling yield and cooking quality. Seed hardness is affected by seed size, shape, density, composition, etc. Seed hardness was determined by measuring the force of breaking a seed using a texture analyzer (TMS-Pro, Food Technology Corporation, USA).

Results: Figure 4.1. Box plot (left) and mean (right) of dry beans for hardness by variety in 2024.

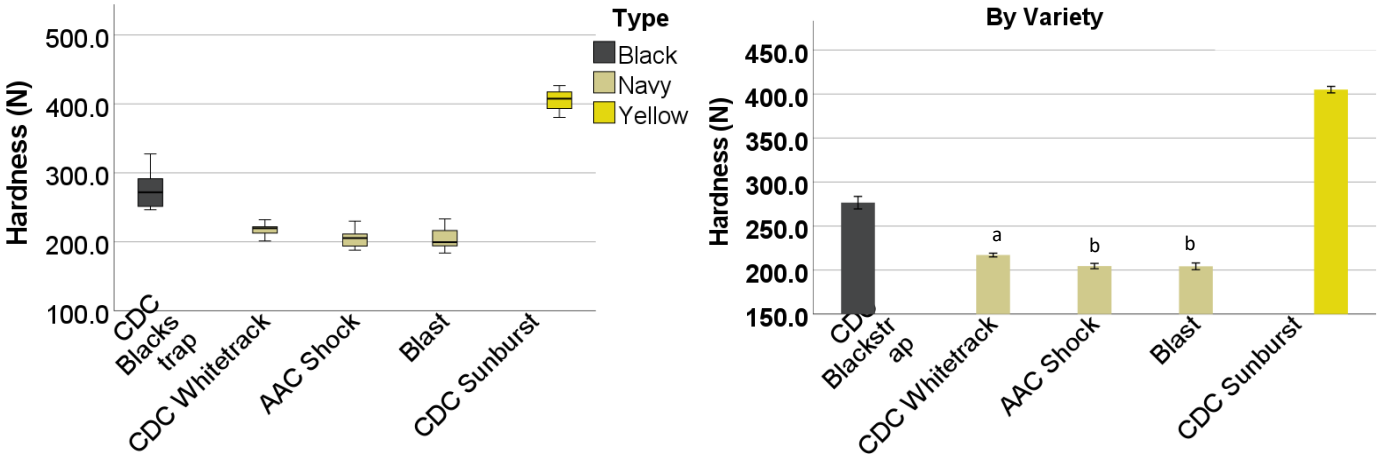

Figure 4.2. Mean hardness of 2024 dry beans by location. Each bar represents mean ± one standard error.

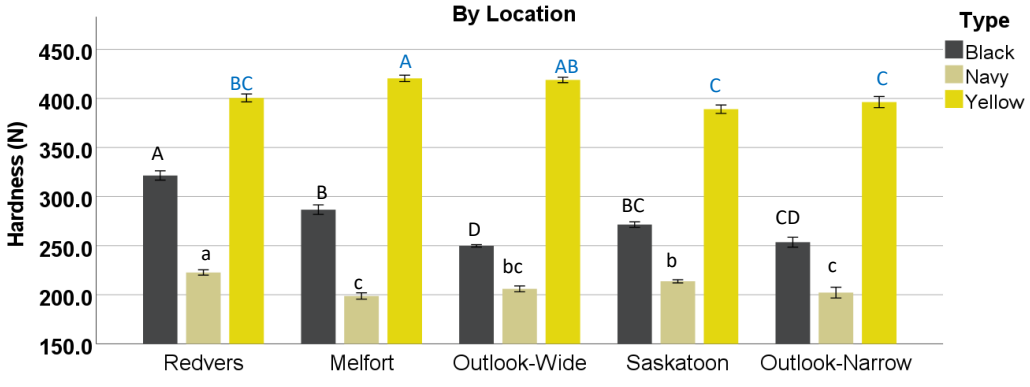

Table 4. Effects of variety and location.

	Navy
Variety	***
Location	***
Variety x Location	**

*Note: ***p<0.001; **p<0.01; *p<0.05; NS not significant*

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5. Ash Content

Method: Ash content (%) was determined using AACC 08-01.01[1] with modification. Samples were heated at 560°C till they turned white. Duplicated measurements were performed for each sample, and the average was reported on a dry basis (d.b.).

Results: Figure 5.1. Box plot (left) and mean (right) of dry beans for ash content by variety in 2024.

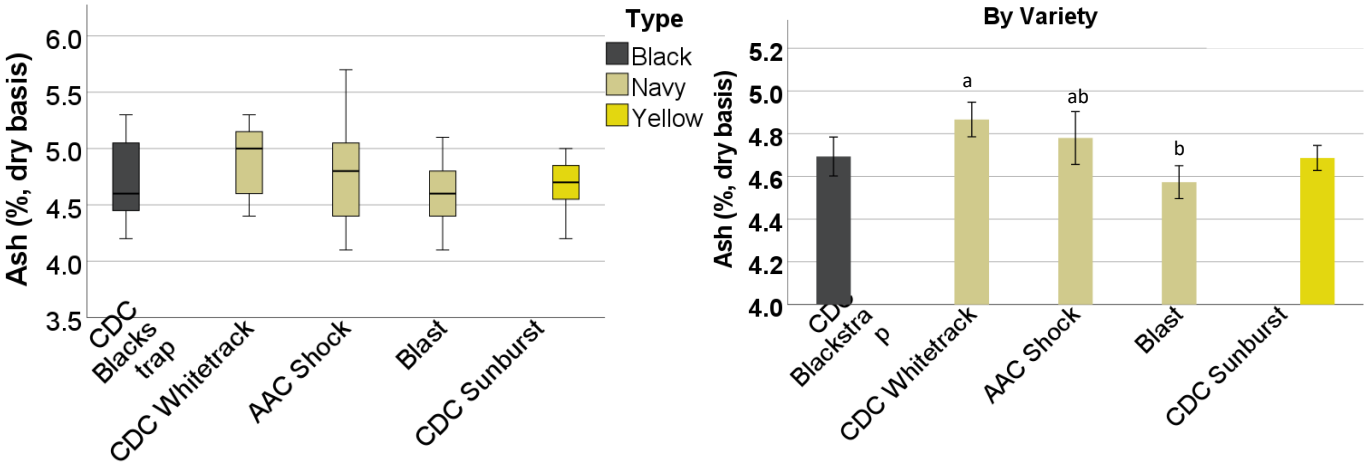

Figure 5.2. Mean ash content of 2024 dry beans by location. Each bar represents mean ± one standard error.

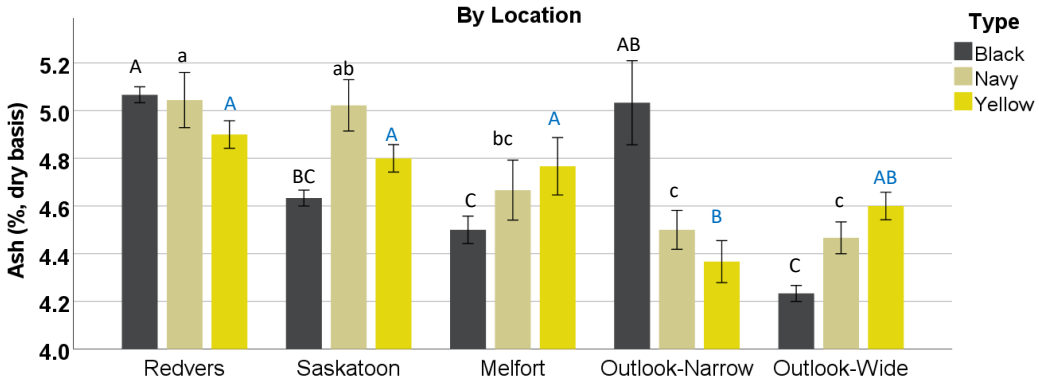

Table 5. Effects of variety and location.

	Navy
Variety	*
Location	***
Variety x Location	*NS*

*Note: ***p<0.001; **p<0.01; *p<0.05; NS not significant*

Note: Capital letters in black indicated significant differences (p<0.05) by black bean. Small letters in black indicated significant differences (p<0.05) by navy bean. Capital letters in blue indicated significant differences (p<0.05) by yellow bean.

[1] AACC (1999). American Association of Cereal Chemists International. Approved methods of analysis (11th ed.). The Saint Pauls Association: Saint Paul, MN.

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6. Protein Content

Method: The protein content (%) of each flour was determined through AACC 46-30[2] using the combustion method through a Rapid N Exceed (Elementar, USA). Duplicated measurements were performed for each sample, and the average was reported on a dry basis (d.b.).

Results: Figure 6.1. Box plot (left) and mean (right) of dry beans for protein content by variety in 2024.

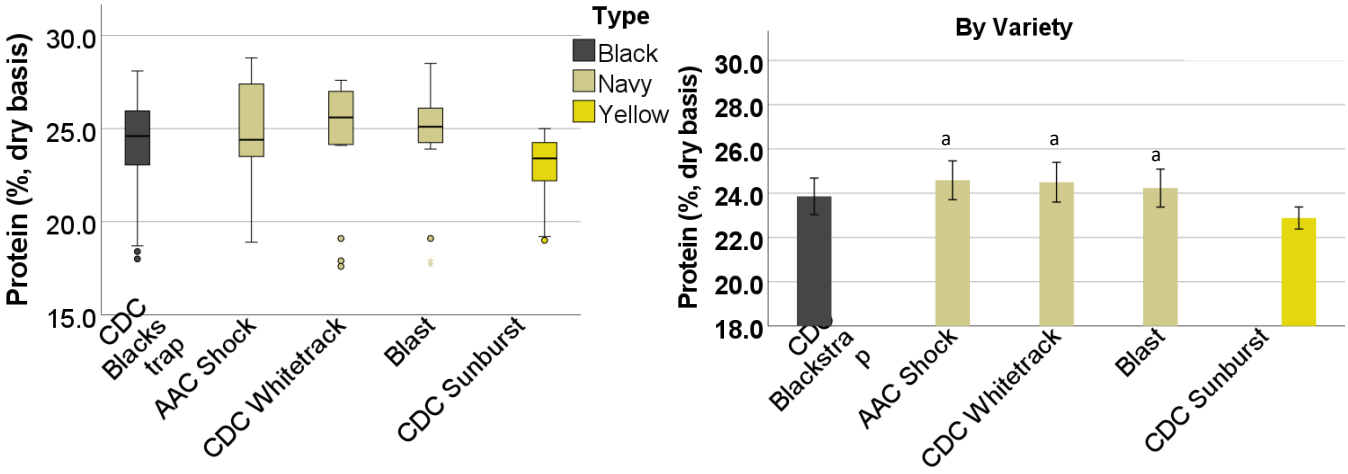

Figure 6.2. Mean protein content of 2024 dry beans by location. Each bar represents mean ± one standard error.

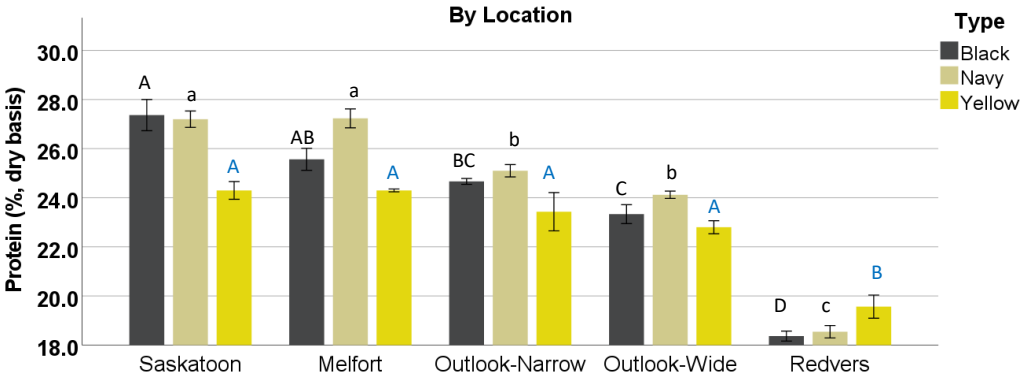

Table 6. Effects of variety and location.

	Navy
Variety	*NS*
Location	***
Variety x Location	**

*Note: ***p<0.001; **p<0.01; *p<0.05; NS not significant*

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7. Protein Productivity

Method: Protein productivity (kg protein/HA), which is calculated using yield (kg/HA) multiplied by protein content (%), refers to the amount of protein produced per unit of land. It evaluates how much protein is being harvested from a given area.

Results: Figure 7.1 Box plot (left) and mean (right) of dry beans for protein productivity by variety in 2024.

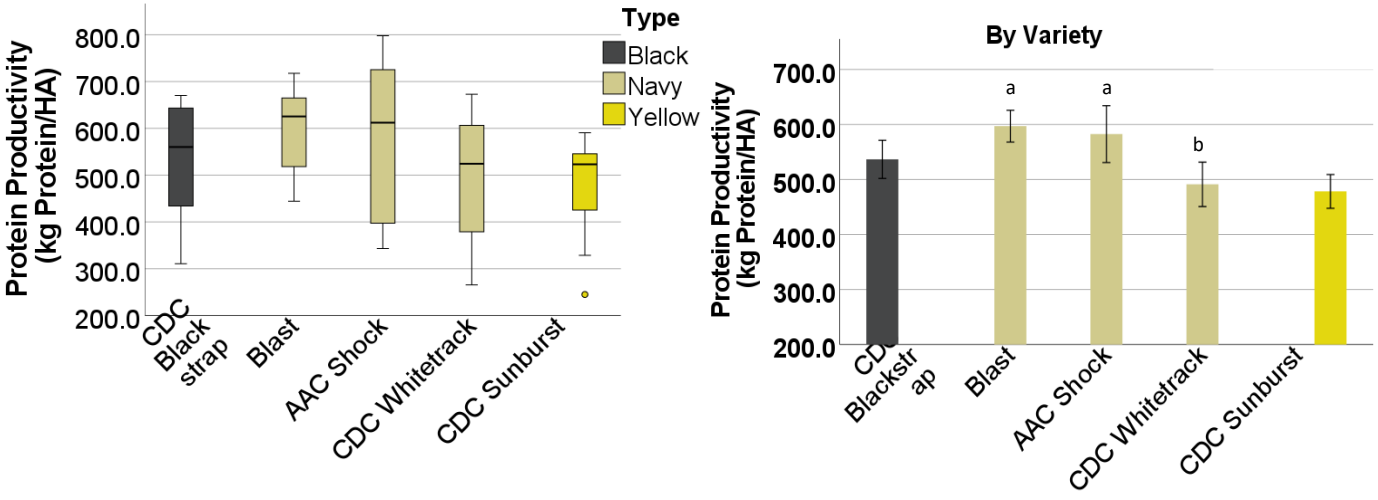

Figure 7.2. Mean protein productivity of 2024 dry beans by location. Each bar represents mean ± one standard error.

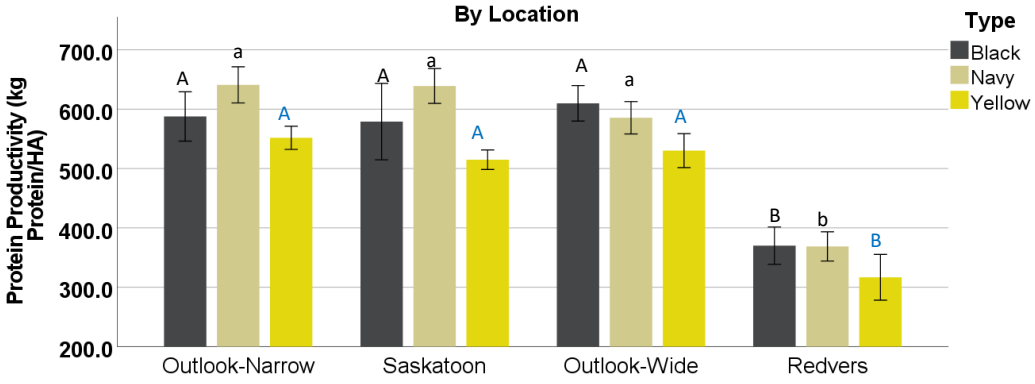

Table 7. Effects of variety and location.

	Navy
Variety	***
Location	***
Variety x Location	*NS*

*Note: ***p<0.001; **p<0.01; *p<0.05; NS not significant*

- Redvers had the lowest yield and protein content, leading to the lowest protein productivity for all types (p<0.05).

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