

Agricultural Experiment Station

College of Agricultural Sciences

Department of Soil & Crop Sciences

Extension

Making Better Decisions



**2017 Colorado
Dry Bean
Variety
Performance
Trials**

Crops
Testing

Table of Contents

Authors.....	3
Acknowledgments.....	3
2017 Colorado Dry Bean Performance Trials.....	4
2017 Irrigated Pinto Bean Variety Performance Trial at Lucerne.....	5
2017 Irrigated Pinto Bean Variety Performance Trial at Yuma.....	6
10-Year Summary of Pinto Bean Variety Performance in Colorado.....	7
Statistical Comparison of Yield Performance of Five Varieties Over Five Years.....	8
Pinto Bean Variety Descriptions.....	9
White Mold of Dry Beans.....	11

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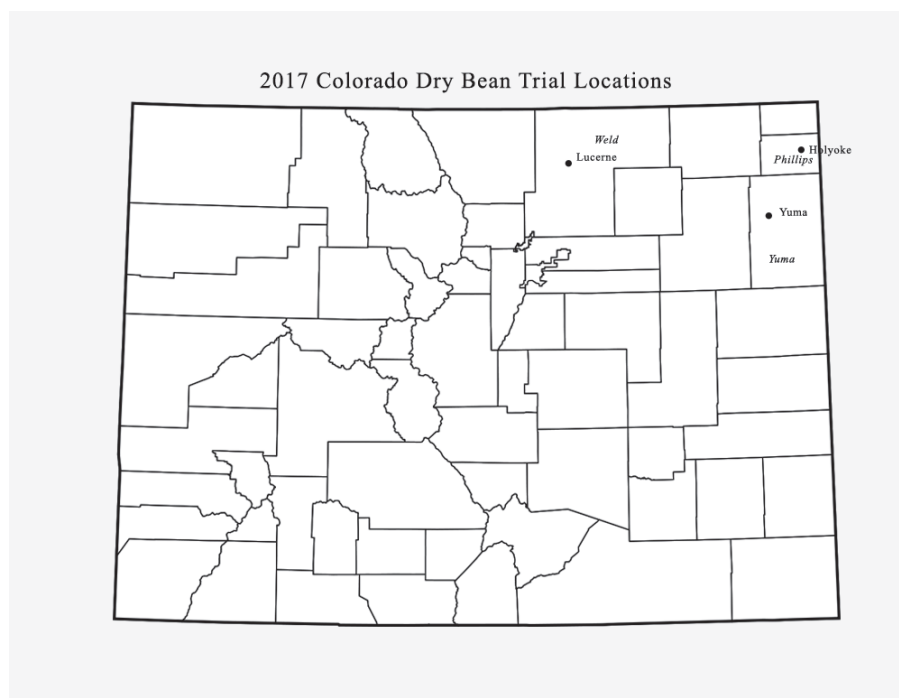
The Colorado State University dry bean improvement team wishes to express their gratitude to the Colorado farmers who voluntarily and generously contributed the use of their land, equipment, and time to facilitate the 2017 dry bean variety trials. We are thankful to the collaborating farmers, Richard Wacker at Yuma, Ed Croissant at Lucerne and Steve Wallin at Holyoke. These trials are evidence of bean check off dollars at work. They would not be possible without research support provided by the Colorado Dry Bean Administrative Committee and the Colorado State University Agricultural Experiment Station. We are also thankful to Larry Lande and Dean Larsen from Northern Feed and Bean in Lucerne, CO and Bill Newth from Trinidad/Benham Bean Co. in Sterling, CO for their assistance in identifying trial collaborators.

2017 Colorado Dry Bean Performance Trials

The Colorado State University Crops Testing Program and the Bean Breeding Program provide unbiased, current, and reliable variety performance results and information to help Colorado dry bean producers make better planting decisions. Our uniform dry bean variety trials serve a dual purpose of screening experimental lines from CSU's Bean Breeding Program as well as testing them alongside commercially available varieties. This allows the breeding program to make variety advancement decisions and helps our program make informed recommendations for Colorado bean producers. Colorado State University promotes crop variety testing as a service to crop producers and seed companies who depend on us for crop variety performance information. The uniform dry bean variety trial is made possible by funding received from Colorado dry bean producers and handlers via the Colorado Dry Bean Administrative Committee, the CSU Agricultural Experiment Station, and CSU Extension.

Dry bean production for 2017 is forecast at 1.12 million hundredweight, up 49 percent from the 751,000 hundredweight produced a year earlier. Yields are expected to average 2,000 pounds per acre, up from 1,750 pounds per acre last year. Growers expect to harvest 56,000 acres this year, up 13,000 acres from the 43,000 acres harvested last year. For Colorado alone, we estimate that the 2017 value of the variety decision made by farmers is about \$453,000. (Assuming 2% per year increase in yield due to testing improved genetics).

Two eastern Colorado pinto bean trials were planted at Yuma and Lucerne in 2017. It is a uniform variety trial wherein all twenty-four varieties with diverse origins, maturities, disease resistance, growth habits, and adaptability were planted in each at the two irrigated trial locations. The results table for these trials are presented in the following pages. We also conducted one kidney bean variety trial at Holyoke that was lost to mixed plots at the time of harvest. Plot sizes of all trials were 300 ft² and all trials were planted at 85,000 seeds per acre. Varieties in each trial were replicated three times. Seed yields and seed sizes for all trial varieties are reported in the tables. Yields are adjusted to 14% seed moisture content.



2017 Irrigated Pinto Bean Variety Performance Trial at Lucerne

Variety	Source	Yield ^a lb/ac	Moisture percent	Seeds/Pound count
PT11-13	USDA-ARS Prosser, WA	4065	10.7	1229
DR Wood	Colorado State University	3956	11.9	1120
33503-5	Colorado State University	3872	11.4	1134
33123-13	Colorado State University	3824	12.3	1181
GTS-907	Gentec Inc.	3821	11.2	1213
23ST-27	USDA-ARS Prosser, WA	3773	10.9	1140
GTS-904	Gentec Inc.	3673	11.2	1166
Centennial	Colorado State University	3646	11.6	1191
Sinaloa	Trinidad-Benham	3604	13.5	1319
34435-15	Colorado State University	3570	11.9	1311
43732-15	Colorado State University	3529	11.2	1140
PT9-5-6	USDA-ARS Prosser, WA	3363	10.1	1319
Montrose	Colorado State University	3357	10.0	1194
43755-3	Colorado State University	3340	10.6	1098
CO 33176-15	Colorado State University	3290	11.7	1123
StayBright (COSD 35)	Colorado State University	3286	12.2	1227
34399-15	Colorado State University	3273	12.6	1172
ND-Palomino	North Dakota State University	3241	10.5	1197
Croissant	Colorado State University	3203	10.9	1223
Sundance (COSD 7)	Colorado State University	3049	12.0	1245
Long's Peak	Colorado State University	3002	12.4	1184
CO 14330-10	Colorado State University	2930	10.6	1250
CO 25069-2	Colorado State University	2917	11.3	1090
El Diablo	Gentec Inc.	2908	11.5	-
Average		3437	11.4	1194
^b LSD (P<0.30)		238		

^aYields corrected to 14% moisture.

^bIf the difference between two variety yields equals or exceeds the LSD value, there is a 70% chance the difference is statistically significant.

Plot Size: 10' x 30'

Site Information

Cooperator: Ed Croissant
 Planting Date: June 2, 2017
 Harvest Date: September 14, 2017
 Fertilizer: N at 173, P at 60, K at 20, S at 5 lb/ac
 Herbicide: Eptam at 2 qt/ac, Dual at 1.33 pints/ac
 Fungicide: Sprayed 2 times with copper
 Soil Type: Weld loam

This table may be reproduced only in its entirety.

2017 Irrigated Pinto Bean Variety Performance Trial at Yuma

Variety	Source	Yield ^a	Moisture	Seeds/Pound
		lb/ac	percent	count
PT11-13	USDA-ARS Prosser, WA	3964	15.6	1093
El Diablo	Gentec Inc.	3881	11.3	1039
CO 33176-15	Colorado State University	3801	21.3	981
GTS-907	Gentec Inc.	3702	11.5	1014
DR Wood	Colorado State University	3678	30.4	1114
GTS-904	Gentec Inc.	3668	15.2	1048
43755-3	Colorado State University	3604	15.8	1049
Montrose	Colorado State University	3543	13.0	1105
PT9-5-6	USDA-ARS Prosser, WA	3483	18.4	1192
33503-5	Colorado State University	3384	23.2	1073
33123-13	Colorado State University	3345	35.4	1153
Long's Peak	Colorado State University	3329	23.8	1081
ND-Palomino	North Dakota State Univsity	3312	28.3	1122
Sinaloa	Trinidad-Benham	3291	16.9	1202
43732-15	Colorado State University	3225	22.2	972
Centennial	Colorado State University	3189	30.1	1201
34399-15	Colorado State University	3130	19.6	1038
Croissant	Colorado State University	3063	17.2	1097
34435-15	Colorado State University	3030	21.1	1061
StayBright (COSD 35)	Colorado State University	3014	34.8	1137
CO 14330-10	Colorado State University	2962	19.0	1089
23ST-27	USDA-ARS Prosser, WA	2818	18.8	1035
CO 25069-2	Colorado State University	2817	18.0	1033
Sundance (COSD 7)	Colorado State University	2800	31.6	1153
Average		3335	21.4	1087
^b LSD (P<0.30)		281		

^aYields corrected to 14% moisture.

^bIf the difference between two variety yields equals or exceeds the LSD value, there is a 70% chance the difference is statistically significant.

Plot Size: 10' x 30'

Site Information

Cooperator: Richard Wacker
 Planting Date: June 2, 2017
 Harvest Date: September 15, 2017
 Fertilizer: N at 100, P at 42, K at 5, and S at 15 lb/ac
 Herbicide: Eptam at 3pt/ac and Dual at 1.5 pint/ac
 Eptam at 3pt/ac and Outlook at 14.0 oz/ac
 Fungicide: Copper applied 3 times
 SaniDate 12.0 applied twice at 1 pint/ac
 Aproach at 12 oz/ac
 Soil Type: Haxtun loamy sand

This table may be reproduced only in its entirety.

10-Year Summary of Pinto Bean Variety Performance in Colorado

Every year CSU personnel conduct pinto bean variety performance trials in different locations in eastern Colorado. Variety entries and locations change from year to year. The following table summarizes variety performance over multiple years. In the table, yield performance by variety has been averaged over locations within each of ten years. Entries reported are public and commercial named varieties common to all trials for a year. Experimental lines are not included in this summary. The number of locations per year varied from one to six. The trial average at the bottom of each year's yield column is a simple average of the yields of reported varieties for that year. Average variety yield over years is shown in the column at the far right. Varieties are ranked according to highest average percent of average yield across each year they were tested. The results cannot be analyzed statistically as not all varieties are tested every year. It should be considered as a graphic representation of cultivar performance over time.

10-Year Summary of Pinto Bean Variety Performance in Colorado Variety Trials from 2006-2017.

Variety ^a	2006	2007	2008	2009	2010	2011	2012	2013	2014	2017	Long Term Average	
						lb/ac						% of avg.
Montrose	3466	2587	4854	3569	3261	2660	3675	1869	3470	3450	3286	107
Sinaloa						2799	3574	1881	3338	3447	3008	105
Poncho	3033	3179	4432		3144						3447	104
Mariah				3033	3105		3798	1982			2980	104
Bill Z	3689	2796	4910	3273	3418	2305	3518	1610			3190	104
GTS-904		3118	3513	2634	3091	2468	3854	2055	3598	3671	3111	103
Windbreaker				3415	3316		3358	1615			2926	101
Galeena	3437	2508	5046	2390	3330						3342	101
La Paz	3164	2586	3804	2177	2917	2700	3676	2416	3558		3000	101
Durango	3170	2390	4457	3136	3244	2301					3116	99
99217	3080	2406	4482	3296	3082	2148					3082	98
Croissant				2855	2792	2479	3236	2079	3250	3133	2832	98
Long's Peak				2973	2786	2684	3329	1842	3117	3165	2842	98
Stampede		2502	4015	3100	3081	2280		1843			2804	97
ND-307				2735	2949	2298		1899			2470	96
Grand Mesa	2944	2429	4450	3132	2864	2204					3004	96
Medicine Hat				2902	2877		3267	1940	2851		2767	95
Lariat		2528	4472	3010	3123	2204		1463			2800	95
Othello	3033				3020		3411	1534	2778		2755	91
Average	3224	2639	4403	2977	3078	2425	3518	1859	3245	3373	2988	

^aThe following varieties were only tested for a few years during the ten year period, and are not included in this performance summary: Baja, Buckskin, Buster, Kimberly, Rally, Shoshone, and Sonora.

Statistical Comparison of Yield Performance of Five Varieties Over Five Years

The table summarizes the analysis of performance of five common varieties in 11 environments (each year/location combination). Interestingly, GTS-904 is significantly higher yielding than both Montrose (CSU's historically high performance variety) and Sinoloa (an AmeriSeed Inc. pinto variety distributed by Seedwest). GTS-904 is from Gentec, Inc. a bean breeding company headquartered in Twin Falls, ID. The remaining varieties, Croissant (good color, seed size and rust resistance) and Longs Peak (bright pinto color, good seed size, disease resistance), are lower yielding than the other three varieties but valued for high quality characteristics and acceptably high yield. Variety maturity, growth habit, seed quality, disease resistance and other characteristics should also be considered to help determine the variety that best suits your growing conditions and needs for a timely harvest of high quality premium seed.

Variety	Yield	
	lb/ac	
GTS-904	3210	A
Montrose	3082	B
Sinaloa	3049	B
Croissant	2929	C
Long's Peak	2787	D
Average	3011	

Pinto Bean Variety Descriptions

- Centennial** Released in 2015 by the Colorado State University (tested as CO 91212-4) to provide dry edible pinto bean variety to growers in the High Plains and western US. Centennial combines resistance to common rust and Bean Common Mosaic Virus (BCMV), excellent seed quality and size, and semi-upright architecture. Centennial possesses the Ur-3 and Ur-6 alleles that condition resistance to strains of rust found in the Hi Plains and western US.
- Croissant** A pinto variety released in 2008 from Colorado State University. Croissant combines good commercial pinto bean traits including excellent seed color and size, acceptably high yield potential, resistance to prevalent strains of rust in the High Plains, and resistance to BCMV and Bean Common Mosaic Necrosis Virus (BCMNV). Croissant has medium harvest maturity (93 to 98 days) and semi-upright plant architecture in most environments.
- DR Wood** Tested as CO14790-3, it is a pinto bean cultivar with excellent seed color and size, and has high yield potential. DR Wood will be released as foundation seed to seed producers in 2018. In the Central High Plains, it is a full season (97 to 100 d) cultivar with semi-upright architecture (Type II). It possesses important disease resistance alleles including: resistance to US strains of bean common mosaic virus, partial resistance to endemic strains of bean common bacterial blight, and resistance to all endemic strains of foliar rust in the Central High Plains and western US.
- El Diablo** A pinto variety released by Gentec, Inc. First tested in our trials in 2017. It is an upright short vine plant type and is a medium to early maturity.
- GTS-904** A pinto variety released by Gentec, Inc that was first tested in our trials in 2007. It is a tall, semi-determinate bush plant that holds pods off the ground and has fair to good lodging resistance. GTS-904 has good yield potential and an upright growth habit which could be suitable for direct harvest. It is a mid-to-full season variety.
- GTS-907** A pinto variety released by Gentec, Inc first tested in our trials in 2013. It is a medium maturity plant with an upright vine plant type.
- Long's Peak** A pinto variety released in 2011 from Colorado State University. Long's Peak combines several desirable commercial pinto bean traits including excellent seed color and size, acceptably high yield potential, resistance to prevalent strains of rust in the High Plains, and resistance to BCMV and BCMNV. Long's Peak has upright plant architecture in most environments and medium plant maturity (94-98 days)
- Montrose** A pinto variety released in 1999 from Colorado State University. Montrose was released to provide a high yielding pinto variety with improved resistance to rust. It is a medium season variety (94-97 days) with a semi-vine type growth habit. Montrose is resistant to all known races of rust in the High Plains and western US. It has excellent seed quality and possesses resistance to curly top virus, BCMV, BCMNV, and it has tolerance to Fusarium root rot. It is highly susceptible to white mold.

- Sinaloa** An AmeriSeed Inc. pinto variety distributed by Seedwest. It has a high yield potential and is a medium-full season maturing variety (96-100 days) with an upright 2B plant type. It matures 3 days earlier than La Paz. It holds pods off the ground and has a medium profile. It has intermediate resistance to rust caused by *Uromyces appendiculatus*.
- StayBright** StayBright (tested as COSD 35) is a slow darkening (SD) seed coat pinto bean variety released by CSU. The slow darkening allele was derived from the germplasm line SDIP-1 by the University of Idaho in 2006. The slow-darkening allele conditions the slow darkening seed coat trait in the homozygous recessive condition. StayBright is resistant to endemic strains of foliar rust in the High Plains and all strains of bean common mosaic virus (BCMV). StayBright has semi-upright architecture. Harvest maturity is 96 to 99 days in the High Plains region.
- Sundance** Sundance (tested as COSD 07) is a slow darkening seed coat pinto bean variety released by CSU. The slow darkening allele was also derived from the germplasm line SDIP-1 by the University of Idaho in 2006. Sundance is also resistant to foliar rust and BCMV. It has semi-upright architecture with harvest maturity of 92 to 95 days in the High Plains.
- ND Palomino** Derived from the cross Santa Fe/PS08-108. Santa Fe is a regular darkening pinto cultivar and PS08-108 F3 is a slow darkening breeding line with 1533-15, the source of slow darkening. ND Palomino has an upright indeterminate (short vine) growth habit (Type 2A), white flowers, and matures in approximately 102 days. ND Palomino is resistant to Bean Common Mosaic Virus (BCMV), but susceptible to both rust and anthracnose diseases. Canning tests were performed by two major canning companies in which they use only two ratings: acceptable or unacceptable. Both companies rated the final canned product as acceptable but warned against mixing/comingling regular darkening with slow darkening beans in the same canning line because the final color of the beans will be very different.

Pinto Bean Experimental Lines

Colorado State University

CO 14790-3
 33503-5
 33123-13
 34435-15
 43732-15
 43755-3
 CO 33176-15
 34399-15
 CO 14330-10
 CO 25069-2

Washington State University

PT11-13
 PT9-5-6
 23ST-27 Slow darkening pinto line pending release as "Scout" in 2018.

White Mold of Dry Beans

Dr. Kirk Broders

One of the most important diseases impacting dry beans in eastern Colorado is white mold caused by the fungus *Sclerotinia sclerotiorum*. Losses from this disease have averaged as high as 20%, with a few individual fields having losses in excess of 65%.

Disease Identification

Symptoms of white mold are first observed as wet, soft spots or lesions on infected leaves, branches, stems and pods. These lesions enlarge into watery, rotten mass of tissue that is covered by a white moldy growth. Infection of stems and branches will cause affected plant parts to wilt and later die, taking on a bleached and dried appearance. This bleaching symptom is characteristic of white mold infected pinto and great northern types and differs from normal tan color resulting from senescence or other diseases. Black and irregularly-shaped sclerotia (survival structures of the fungus) form on and within infected plant parts. These sclerotia can then survive on or in the soil until the next cropping season.

Disease Cycle

The fungus *S. sclerotiorum* has a wide host range and is able to infect numerous crops such as alfalfa, potato, pepper, soybean and sunflower. In addition, weeds including amaranths, lambsquarter and pigweed can serve as hosts. The white mold disease cycle starts with sclerotia located near the upper 2-cm of soil surface germinate and produce a mushroom-like structure which produces millions of spores over several days (Fig. 1). Multiple apothecia can sprout from the sclerotia over the course of several weeks. These spores can be dispersed locally and only rarely are dispersed to other locations. Under some conditions sclerotia may germinate and produce thread-like hyphae, which infect plant roots, crowns, and other low-lying plant parts.

Germination of sclerotia occurs under cool (50-68°F) periods typically following heavy rains or irrigation. A 16-48 hour wet period is required for the production of spores, which are forcibly discharged and moved by air currents to susceptible plant tissue (Figure 1). Infection often takes place on flowers and once inside the plant, the fungus grows and produces stem lesions that eventually girdle the stem. Sclerotia form in or on plant tissues, where they eventually fall from plants or overwinter inside senesced stems on the soil surface (Figure 1).

Unlike foliar diseases such as bean rust, white mold only produces one set of infective spores per season. Plant- to-plant spread is possible if adjacent plants come into contact with diseased plants, particularly under humid conditions. Development of white mold ceases when temperatures reach around 90°F or the environment dries out. Moderate air temperatures, frequent rain or irrigation, and high humidity from flowering through pod development also favors disease development. In addition, beans with dense canopies or rapid canopy closure tend to be most susceptible to the disease. Yield loss is often associated with disease incidence in the field.

Management

No single management method effectively prevents the infection process from occurring; however, research has indicated that several measures can help reduce damage from white mold, thereby minimizing yield losses. The following management practices should be

followed if you have fields with consistent white mold disease pressure:

1. Long rotations to corn, wheat or other small grains can help reduce inoculum by stimulating germination of sclerotia. Short rotations between corn/wheat and beans or other susceptible hosts (sunflower, soybean, potato) can increase the buildup of inoculum over time.
2. Avoid over-fertilization. Thick dense plant growth that results from excessive fertilization causes the canopy to close sooner resulting in cooler more humid condition within canopies, creating an ideal environment for white mold development.
3. Space rows at the widest distance that will maintain maximum yields. It is important to avoid high plant population and narrow rows. This will also cause the canopy to close sooner favoring disease development
4. Avoid excessive irrigation. Efficient use of irrigation water is important since disease development depends on there being moist soil beneath the canopy. Infection can be reduced by keeping the soil surface as dry as possible during pod fill and maturation.
5. Harvest fields with white mold last to avoid introducing the diseased plant tissue or sclerotia attached to equipment into other fields.
6. Timing of fungicide application. This is critical to protect as many blossoms as possible from infection. Fungicides must be applied in sufficient volume of water to provide thorough coverage of all susceptible plant parts.

If a susceptible variety is planted in a field with a history of disease, treatment with a fungicide may be needed. During the season white mold can be managed with the use of fungicides including Thiophanate-methyl (FRAC group 1), Boscalid (FRAC group 7), and/or Prothioconazole (FRAC group 3) groups. Review recent fungicide efficacy trials (<https://www.ag.ndsu.edu/carringtonrec/plant-pathology/fungicide-efficacy-testing-results-2013-dry-edible-beans>) to compare a more extensive list of compounds currently registered for use on dry beans. These products are most effective if applied at R1 (every plant has one or more open blossoms) growth stage, before symptoms develop. Fungicide applications made later or after disease is detected may not provide adequate disease control. Canopy penetration and coverage are essential to manage white mold with fungicides. Follow all label directions whenever using fungicides

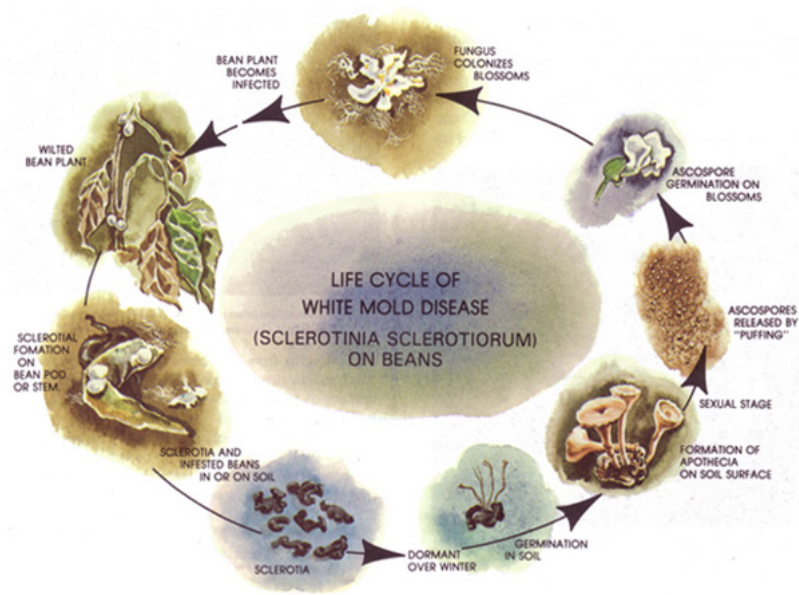
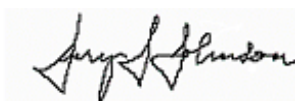


Figure 1. Life cycle of white mold disease (<http://extension.colostate.edu/topic-areas/agriculture/white-mold-of-dry-beans-2-918/>)

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