

Request for Release of NDC160236 Chickpea

Date: January 17, 2024

Team Members/Agencies Cooperating in Development Work:

Montana State University
North Dakota State University

Identification:

Market Class: Kabuli chickpea

Selection Number: NDC160236

Proposed Name: undecided

Pedigree: FLIP94-99c/'Progres'

General Situation:

1. Unique cultivar characteristics

The unique characteristic of NDC160236 is its high yield potential in Montana environments from 2017-2023 and its larger seed size compared to the widely grown cultivar, 'CDC Frontier'.

2. Need for cultivar

The chickpea industry in the US produced 240,000 MT of chickpeas on 372,400 hectares in 2023. Large chickpeas accounted for 72% of the overall production. Montana produced 101,000 MT of chickpeas on 174,000 acres while North Dakota produced 16,000 MT of chickpea on 22,000 acres. Nationally Montana and North Dakota account for 47 and 6% of US chickpea production, respectively. In 2022, the chickpea crop was valued at \$122 million nationally. Release of NDC160236 will fill the need of the US industry for a large-seeded chickpea with high yield and larger seed size than CDC Frontier.

3. Variety to supplant

'CDC Frontier' and 'CDC Orion'

Performance Evaluations:

NDC160236 was evaluated in 17 nurseries from 2017 – 2023 in Montana. Tables 2-5 summarize data from the 2017 -2023 Chickpea Variety Trials in MT. NDC160236 produced an average seed yield of 2323 lb/a across all trials from 2017 - 2023. NDC160236 yielded 13, 7, and 17% more than CDC Frontier (2055 lb/a), CDC Orion (2584 lb/a), and ND Crown (2255 lb/a), respectively,

over 17 site-years. All checks are similar type chickpeas developed by the Crop Development Center in Saskatoon, Saskatchewan, Canada or North Dakota State University. NDC160236 had excellent agronomic performance in 2017 - 2023 and an average plant height of 42 cm compared to 40 cm for CDC Frontier (Table 6). NDC160236 flowers and matures 0 days earlier than the CDC Frontier and ND Crown and 5 days later than CDC Orion. Seed size for NDC160236 is larger than CDC Frontier (6.8%) and 10.6% and 4.5% smaller than CDC Orion and ND Crown, respectively. Across 8 site-years, NDC160236 had 60% of its seed remain on top of a 22/64 round hole sieve classifying it as a large chickpea based on crop insurance standards. NDC160236 had 11% of its seed remain on top of a 24/64 round hole sieve whereas CDC Frontier, CDC Orion and ND Crown had 5, 26 and 22% remain on top of a 24/64 round hole sieve. Its seed size and greater seed yield distinguish NDC160236 from currently available cultivars and justifies its consideration for release.

Other Agronomic Traits:

1. Flowering Date: NDC160236 flowers in 72 days from planting.
2. Plant Height: NDC160236 had an average height of 42cm.
3. Seed Size: 1000-seed weight for NDC160236 was 385gm compared to 361gm for CDC Frontier. Seed size distribution for NDC160236 also has a greater proportion of larger seed (Table 6-8).
4. End-use Quality: Physical seed appearance of NDC160236 is acceptable for the market. The larger seed size will allow this variety to be sold markets for both whole seed as well as processed markets, such as hummus.
5. Disease Resistance: NDC160236 has equal or better resistance to Ascochyta blight compared to other chickpea varieties. Data collected at Carrington REC in 2018-2019 showed that disease incidence score (DIS) of Ascochyta blight was 55.3% for NDC160236 and 56.3% for CDC Frontier in 2018 when the susceptible check, Sierra, had a DIS of 93.0%. In 2019, a much more severe year for Ascochyta blight, DIS for NDC160236 was 82.5% and ND Crown, CDC Frontier and CDC Orion had scores of 78.8, 92.0 and 92.5%, respectively. DIS for Sierra, the susceptible check was 100%. All disease scores were provided by Dr. Michael Wunsch at the Carrington Research Extension Center (Table 1).
6. Weaknesses: There are no apparent weaknesses of NDC160236.

Seed source, Status and Availability:

Two hundred single plants were harvested from the field at the Arthur H. Post Farm near Bozeman, MT in 2019. Seed harvested from these plants was grown in single rows in the 2021 field season at the Post Farm, as the initial increase of pre-breeder seed. Harvested seed was increased in the field in MT in 2022 and again 2023. Current stock of NDC160236 with the MT Foundation Seed Program is 500 bushels of Breeder seed. It is proposed that this seed be increased in the 2024 field season to produce Foundation seed. North Dakota State University currently has 2000 lb or 33 bushels of Breeder seed that is also slated for increase in 2024.

Probable date for release:

July 2025

Provisions for PVP:

Plant Variety Protection will be sought for NDC160236. Data to support this application will be collected during the 2024 field season.

Table 1. Disease incidence score for chickpea breeding lines evaluated at the Carrington Research and Extension Center in Carrington, ND in 2018 and 2019.

Name	2018*	2019	Mean
	Ascochyta Blight %	Ascochyta Blight %	
NDC160220	53.8	70.0	61.9
NDC160221	53.3	75.5	64.4
NDC160236	55.3	82.5	68.9
NDC150001	58.3	87.5	72.9
<i>CDC</i>			
<i>FRONTIER</i>	56.3	92.0	74.1
NDC160151	60.0	89.0	74.5
NDC160194	55.5	93.5	74.5
NDC110213	59.3	90.0	74.6
NDC160131	59.5	90.8	75.1
NDC160049	64.8	89.3	77.0
NDC160133	60.8	93.8	77.3
<i>ND CROWN</i>		78.8	
NDC160186	71.8	93.0	82.4
<i>CDC ORION</i>		92.5	
<i>SIERRA</i>	93.0	100.0	96.5
NASH		100.0	100.0
DWELLEY		100.0	100.0
EVANS		100.0	100.0
ROYAL		100.0	100.0
SAWYER		100.0	100.0
Grand Mean	71.7	90.9	
C.V.	8.0	5.9	
LSD	6.7	6.3	

* Only common entries between 2018 and 2019 experiments are shown. The 2018 statistics reflect all the entries.

Table 2. Mean performance of chickpea breeding lines tested at Bozeman, MT, Havre, MT, and Richland, MT in 2020.

Name	Seed Yield lb/a	1000 Seed Weight g	24/64 %	22/64 %	20/64 %	18/64 %	<18/64 %	>22/64 %
NDC160236	2938	403	11	47	36	6	0	58
NDC160151	2872	371	5	41	46	7	0	47
NDC160220	2850	362	3	35	52	10	0	37
NDC160133	2801	376	6	41	45	8	0	47
NDC160147	2779	372	5	40	48	9	0	44
NDC160111	2779	337	1	15	70	13	0	15
NDC160131	2761	361	4	39	45	12	0	43
<i>CDC ORION</i>	2747	440	26	47	25	2	0	73
NDC160006	2730	379	17	37	26	19	1	54
NDC160062	2643	345	2	23	61	13	1	25
NDC160194	2637	379	13	40	31	14	1	54
NDC160013	2602	418	23	41	29	7	0	64
<i>ND CROWN</i>	2574	412	22	44	28	6	0	66
<i>CDC</i>								
<i>FRONTIER</i>	2551	361	5	36	49	10	0	41
NDC160153	2499	369	7	41	43	10	0	47
NDC160045	2498	334	1	18	57	23	1	19
NDC160152	2493	355	3	34	50	12	1	37
NDC160157	2480	370	4	38	50	7	0	42
NDC160186	2463	348	4	32	48	16	1	36
NDC160221	2356	402	10	37	45	7	0	48
NDC160049	2316	363	8	41	35	15	1	49
NDC110213	2248	347	4	33	51	11	0	37
NDC150001	2133	402	14	40	37	7	0	54
NASH	1729	552	60	24	13	2	0	84
SIERRA	1524	486	44	36	16	3	0	80
GRAND MEAN	2520	386	12	36	41	10	0	48
CV								
LSD								

Table 3. Mean performance of chickpea breeding lines tested at Bozeman, MT in 2021.

Name	Days to Flower	Bloom Period	Days to Maturity	Vine Length	Canopy Height	Plant Height Index	1000 Seed Weight	Seed Yield
	days	days	days	cm	cm		g	lb/a
NDC160236	66	14	101	34	35	1.01	402	1632
CDC FRONTIER	66	14	101	36	30	0.86	387	1484
CDC ORION	59	19	100	33	28	0.84	446	1400
NDC160221	66	13	100	38	36	0.95	344	1393
ND CROWN	66	12	102	37	36	0.96	427	1359
SIERRA	68	6	101	36	34	0.95	492	1205
NDC160194	65	9	101	40	35	0.90	423	1202
GRAND MEAN	65	12	101	36	33	0.92	417	1382
CV	2.9	21.7	0.7	7.4	5.3	7.3	2.2	6.0
LSD	3	4	1	4	3	0.10	14	122

Table 4. Mean performance of chickpea breeding lines tested at Bozeman, MT in 2022.

Name	Days to Flower	Days to Maturity	1000		>24/64	>22/64	>20/64	>18/64	<18/64
			Seed Weight	Seed Yield	Round Sieve	Round Sieve	Round Sieve	Round Sieve	Round Sieve
	days	days	gm	lb/a	%	%	%	%	%
<i>CDC ORION</i>	70	123	466	2252	28	57	14	1	0
NDC160236	74	125	426	2164	12	63	23	2	0
<i>ND CROWN</i>	74	124	445	2093	36	45	15	3	0
<i>CDC FRONTIER</i>	74	124	390	2003	4	64	30	2	0
NDC160194	75	124	440	1933	20	65	13	1	0
NDC160221	75	125	357	1708	1	50	43	5	1
SIERRA	73	124	508	1543	59	32	8	1	0
GRAND MEAN	74	124	433	1957	23	54	21	2	0
CV	1.2	1.2	2.0	4.5	20.5	17.8	39.6	50.9	181.8
LSD	1	2	10	108	6	12	10	1	0

Table 5. Mean performance of chickpea breeding lines grown at Bozeman, MT in 2023.

Name	Days to Flower	Days to Maturity	Bloom Period	Vine Length	Canopy Height	Plant Height Index	Seed Yield
	days	days	days	cm	cm		lb/a
NDC160236	60	107	22	60	61	1.04	3350
NDC160147	60	113	21	59	56	0.96	3305
<i>CDC FRONTIER</i>	<i>60</i>	<i>113</i>	<i>23</i>	<i>60</i>	<i>58</i>	<i>0.96</i>	<i>3283</i>
<i>ND CROWN</i>	<i>59</i>	<i>112</i>	<i>22</i>	<i>64</i>	<i>63</i>	<i>0.99</i>	<i>3251</i>
NDC160153	59	113	22	63	61	0.97	3214
NDC160045	61	111	22	65	64	1.00	3163
<i>CDC ORION</i>	<i>54</i>	<i>112</i>	<i>27</i>	<i>58</i>	<i>57</i>	<i>0.99</i>	<i>3138</i>
NDC160131	59	110	24	59	62	1.05	3074
NDC160194	59	110	21	63	65	1.03	3003
SAWYER	57	112	23	61	59	0.98	2936
NDC160151	59	112	21	62	59	0.97	2927
NDC160152	61	112	19	62	59	0.96	2898
NDC160157	61	113	21	64	73	1.15	2896
NDC160062	60	111	21	74	74	1.00	2875
CDC LEADER	60	108	20	55	57	1.02	2840
NDC160049	59	114	21	69	65	0.95	2835
NDC150001	61	114	21	66	64	0.98	2777
CDC PALMER	57	109	25	50	46	0.92	2674
NDC160111	62	114	19	70	67	0.96	2645
NDC160221	60	107	22	67	63	0.95	2542
NASH	60	114	20	60	57	0.99	2501
NDC160013	59	109	20	70	76	1.09	2494
NDC160220	59	108	22	64	64	1.01	2484
NEW HOPE	60	114	20	63	68	1.08	2427
NDC110213	61	111	20	65	63	0.99	2386
ROYAL	60	113	19	60	60	1.01	2349
EVANS	57	111	24	68	66	0.97	2300
SIERRA	59	115	23	57	60	1.06	2231
DWELLEY	59	114	19	58	56	0.97	2162
NDC160006	60	110	20	67	65	0.97	2062
Grand Mean	59	111	21	63	62	1.00	2767
C.V.	1.5	1.5	7.7	5.5	7.2	7.5	10.7
LSD	2	3	3	6	8	0.13	503

Table 6. Head-to-head comparison of NDC160236 to CDC Frontier based on 2017 - 2023 data.

Trait	n	Mean Values		% of Check	t-value	Significance
		NDC160236	CDC Frontier			
Days to First Flower	17	61	61	100%	0.31	ns
Days to Maturity	17	108	108	100%	0.90	ns
Vine Length (cm)	17	42	40	106%	-2.14	**
1000 Seed Weight (g)	17	385	361	107%	-4.06	***
Seed Yield (lb/a)	17	2323	2055	113%	-3.12	***
24/64 (9mm) (%)	8	11	4	308%	-4.12	***
22/64 (8mm) (%)	8	50	42	119%	-1.78	ns
20/64 (8mm) (%)	8	35	46	76%	3.83	*
18/64 (7mm) (%)	8	5	9	55%	1.89	*

Significance - ns = no significant difference, * = $p < 0.10$, ** = $p < 0.05$, *** = $p < 0.01$

Table 7. Head-to-head comparison of NDC160236 to CDC Orion based on 2017 - 2023 data.

Trait	n	Mean Values		% of Check	t-value	Significance
		NDC160236	CDC Orion			
Days to First Flower	13	62	57	110%	10.85	***
Days to Maturity	13	110	110	100	-0.73	ns
Vine Length (cm)	13	49	45	108%	-2.58	**
1000 Seed Weight (g)	13	398	439	91%	8.01	***
Seed Yield (lb/a)	13	2584	2412	107%	-1.84	*
24/64 (9mm) (%)	8	11	26.6	39%	3.74	***
22/64 (8mm) (%)	8	50	47	105%	-0.51	ns
20/64 (8mm) (%)	8	35	23	152%	-4.19	***
18/64 (7mm) (%)	8	5	3	166%	-1.94	*

Significance - ns = no significant difference, * = $p < 0.10$, ** = $p < 0.05$, *** = $p < 0.01$

Table 8. Head-to-head comparison of NDC160236 to ND Crown based on 2017 - 2023 data.

Trait	n	Mean Values		% of Check	t-value	Significance
		NDC160236	ND Crown			
Days to First Flower	15	61	59	102%	-3.47	***
Days to Maturity	15	106	105	101%	-0.99	ns
Vine Length (cm)	15	40	42	97%	1.14	ns
1000 Seed Weight (g)	15	382	396	97%	1.73	ns
Seed Yield (lb/a)	15	2256	1932	117%	-3.68	***
24/64 (9mm) (%)	6	10	26	40%	2.43	*
22/64 (8mm) (%)	6	49	41	121%	-1.59	ns
20/64 (8mm) (%)	6	35	28	126%	-4.30	***
18/64 (7mm) (%)	6	5	5	100%	0.37	ns

Significance - ns = no significant difference, * = $p < 0.10$, ** = $p < 0.05$, *** = $p < 0.01$

