

OBJECTIVE DESCRIPTION OF VARIETY

Corn (*Zea mays* L.)

INSTRUCTIONS

Please read instructions carefully before completing the attached form. The Objective Description Form is a necessary part of an application for Plant Variety Protection (Breeder's Rights) in the United States of America. It is designed to guide the applicant in describing a corn inbred variety in detail so that comparisons with other corn inbred varieties may be done in a meaningful way. To aid in this goal, data collectors and breeders from different locations should collect the data in a similar fashion. These instructions describe the way in which to take each measurement needed to complete this form. It is possible that some traits are unobtainable for a certain type of corn, causing some blanks to be left empty. It is in your best interest to describe your inbred variety as completely as possible to establish an adequate variety description.

The applicant's name and complete address should be at the top of the form. The country should be included since it is needed when mailing to some areas. The name of the inbred variety is also entered at the top of the form. The Plant Variety Protection Office will assign a unique PVPO Number to each application and enter it below the inbred variety name.

In general, for this form, measurements of quantitative traits should be taken in one trial on 15-25 randomly selected plants to obtain averages and statistics that describe a typical field of the variety. Trials should be done preferably in one location, with replicates, in the region of best adaptability (where the variety will grow and perform to its best potential). Trials should include the application variety plus all comparison varieties. (Please note that to complete the examination process and to establish the distinctness of the application variety, the trial protocol needs to be performed in 2-3 years. In cases where a shortened time period (one year) is desired, you may substitute 2-3 distinct geographical locations within the region of best adaptability, with replicates in each location. See the notes about Exhibit B claims at the end of these instructions.)

1. TYPE

- Choose the kernel type that best describes your variety. If it is a combination of two types (e.g. flinty dent), or a type not listed on the form, then describe it in more detail in the Comments section.

2. REGION WHERE BEST ADAPTED

- Choose one region where the inbred variety is expected to grow best. Indicate where the data to complete this form were collected in the Comments section of the form.
- Indicate the seed source of the standard inbred, including lot number or row number, which has been certified for use in PVP applications.

3. MATURITY

- Although heat units, or growing degree units, are considered to be more accurate than days to maturity, BOTH values may be necessary to differentiate your variety from all other varieties in the database. **Show the formula used to calculate "heat units" in the Comments section of the form.**

4. PLANT

For each of the measurable traits, **report the number of plants measured and the standard deviation.**

$$\text{Standard Deviation} = \sqrt{\frac{\sum (X - \bar{X})^2}{(N - 1)}}$$

- Measure plant height from ground level to tip of tassel.
- Measure ear height from ground level to the base of the node from which the top ear develops.
- Measure length of internode located between the top ear node and the node above it.
- Measure the average number of tillers per plant.
- Measure the average number of ears per stalk.
- Report the presence or absence of anthocyanin in the brace roots.

5. LEAF

For each of the measurable traits, **report the number of plants measured and the standard deviation.**

- Measure the width of the leaf at the top ear node at its widest point.
- Measure the length of the leaf at the top ear node.
- Count the number of leaves above the top ear node.
- Report the adaxial angle between the stalk and the second leaf above the ear at anthesis.
- Report the color of the second leaf above the ear at anthesis. Color codes are listed on page 1. List the Munsell color code also.
- Rate leaf sheath pubescence at the second leaf above the ear at anthesis on a scale from 1 (none) to 9 (like peach fuzz).
- Rate the presence of marginal waves on a scale from 1 (none) to 9 (many). Determine this rating by observing the leaf sides in relation to the leaf's central axis.
- Rate the presence of creases that run parallel to the veins on the leaf blade on a scale from 1 (none) to 9 (many).

6. TASSEL

For each of the measurable traits, **report the number of plants measured and the standard deviation.**

- Count the number of lateral tassel branches that originate from the central spike only.
- Report the adaxial angle between the central spike and the primary lateral tassel branch from the top at anthesis.
- Report the length of the tassel from the top leaf collar to the tassel tip.
- Rate the amount of pollen shed on a scale of 0 (male sterile) to 9 (heavy shed).
- Report the color of the anthers and the glumes. Evaluate the colors in the fresh stage after exposure to the sun to allow for pigment development. Color codes are on Page 1. List the Munsell color code also.
- Report whether the glumes have colored bars perpendicular to their veins.

CORN (*Zea mays* L.)
INSTRUCTIONS (CONTINUED)

7a. EAR

Judge the following characteristics on an unhusked ear.

- Report the color of the silks at the silking stage. Evaluate the color in the fresh stage after exposure to the sun to allow for pigment development. Color codes are on Page 1. List the Munsell color code also.
- Report the fresh husk color as it appears 25 days after 50% silking.
- Report the dry husk color as it appears 65 days after 50% silking.
- Report the position of the ear 65 days after 50% silking.
- Report the tightness of the husk 65 days after 50% silking on a scale from 1 (very loose) to 9 (very tight).
- Report how far the husk extends past the end of the ear at harvest time.

7b. EAR

Judge the following characteristics on a DRY (at least 12-13% grain moisture), husked ear. For each of the measurable traits, **report the number of plants measured and the standard deviation.**

- Measure the length of the ear from butt to tip.
- Measure the diameter of the ear at the mid-point of its length.
- Measure the weight of the husked ear. This should be at the seed stage, not the edible stage.
- Report the average number of rows of kernels on the ear. If rows are indistinct, report the average number of kernels located along the circumference of the ear at the mid-point of its length.
- Report whether kernels are in identifiable rows or not.
- Report how rows of kernels are aligned from butt to tip.
- Measure the length of the ear shank from the butt of the ear to the ear node on the stalk.
- Report the amount of taper to the ear.

8. KERNEL

Judge the following characteristics on DRY (at least 12-13% grain moisture) kernels. For each of the measurable traits, **report the number of plants measured and the standard deviation.**

- Measure the length of kernels
- Measure the width of kernels.
- Measure the thickness of kernels.
- Measure the percent of round kernels in an unsized sample using a 13/64 inch slot screen.
- This characteristic is most important in describing ornamental corns and some popcorns. The aleurone is a very thin layer of cells located between the pericarp and the hard endosperm. Scrape away the skin-like pericarp to expose the aleurone, which will remain attached to either the inside of the pericarp or the outside of the hard endosperm. Report the color pattern and the color of the aleurone. Color codes are on Page 1. List the Munsell color code also. Describe, if necessary, in the Comments section or in the Exhibit D.
- Scrape away the pericarp and aleurone to expose the hard endosperm. Report the color of the hard endosperm. Color codes are on Page 1. List the Munsell color code also. Describe, if necessary, in the Comments section or in Exhibit D.
- Report the endosperm type.
- Measure the weight of 100 kernels taken from an unsized sample.

9. COB

- Measure the diameter of the cob at the mid-point of its length. Report the number of plants measured and the standard deviation.
- Report the color of the cob. Color codes are on Page 1. List the Munsell color code also.

10. DISEASE REACTION

11. INSECT REACTION

- Test as many disease and insect reactions as possible BEFORE applying for protection. BEST: Test reactions for at least the 5 most common diseases or insects for the region in which the inbred variety is best adapted. Many older inbred varieties were tested extensively for disease and insect reactions. More complete information in these sections of the application may speed the determination of distinctness.
- Rate the application variety and the standard inbred variety on a scale of 1 (most susceptible) to 9 (most resistant) for each disease or insect reaction being reported.

12. AGRONOMIC TRAITS

- Rate the stay green ability of the inbred variety as it appears 65 days after anthesis. The rating scale is from 1 (worst stay green; early die-back) to 9 (best stay green: late die-back)
- Report the percent of dropped ears at 65 days after anthesis.
- Report the percent of brittle snapping before anthesis.
- Report the percent of root lodging before anthesis.
- Report the percent of root lodging at 65 days after anthesis.
- Report the dry (at 12-13% grain moisture) corn yield of the inbred per se. Do not use this to establish novelty of an inbred line.

13. MOLECULAR MARKERS

- Report whether molecular marker data are available. Applicants are encouraged to obtain and submit molecular marker data to facilitate variety description. Isozyme data will be added to the computer description of the inbred variety, in preparation for future use of this data in distinguishing between inbred varieties. (The database is not yet capable of distinguishing two inbred varieties solely on the basis of molecular information, so morphological descriptors will continue to be necessary for all applications.) Other molecular marker data submitted with an application will be included in the official description of the inbred variety stored in the Plant Variety Protection Office archives.

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0581-0055. The time required to complete this information collection is estimated to average 3.5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

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**U.S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
SCIENCE AND TECHNOLOGY
PLANT VARIETY PROTECTION OFFICE**

Exhibit C

**OBJECTIVE DESCRIPTION OF VARIETY
Corn (*Zea mays* L.)**

NAME OF APPLICANT (S)	TEMPORARY OR EXPERIMENTAL DESIGNATION	VARIETY NAME
ADDRESS (Street and No. or RD No., City, State, Zip Code, and Country)		<div style="background-color: #cccccc; padding: 2px;">FOR OFFICIAL USE ONLY</div> PVPO NUMBER

PLEASE READ ALL INSTRUCTIONS CAREFULLY AND COMPLETE AS MUCH AS POSSIBLE:

1. TYPE: (Describe intermediate types in Comments section)

___ 1 = Sweet 2 = Dent 3 = Flint 4 = Flour 5 = Pop 6 = Ornamental 7 = Pipecorn
8 = Other (specify) _____

2. REGION WHERE DEVELOPED:

___ 1 = Northwest 2 = North central 3 = Northeast 4 = Southeast
5 = South central 6 = Southwest 7 = Other _____

3. MATURITY (In Region Best Adaptability: show Heat Unit Formula in Comments section):

DAYS	HEAT UNITS	
_____	_____	From emergence to 50% of plants in silk
_____	_____	From emergence to 50% of plants in pollen
_____	_____	From 10% to 90% pollen shed
_____	_____	From 50% silk to optimum edible quality
_____	_____	From 50% silk to harvest at 25% moisture

4. PLANT:

	Standard Deviation	Sample Size
_____ cm Plant Height (to tassel tip)	_____	_____
_____ cm Ear Height (to base of top ear node)	_____	_____
_____ cm Length of Top Ear Internode	_____	_____
___ Average Number of Tillers	_____	_____
___ Average Number of Ears per Stalk	_____	_____
___ Anthocyanin of Brace Roots: 1 = Absent 2 = Faint 3 = Moderate 4 = Dark		

5. LEAF:	Standard Deviation	Sample Size
____. ____ cm Width of Ear Node Leaf	_____	_____
____. ____ cm Length of Ear Node Leaf	_____	_____
____ Number of leaves above top ear	_____	_____
____ degrees Leaf Angle (measure from 2nd leaf above ear at anthesis to stalk above leaf)	_____	_____
____ Leaf Color (Munsell Code _____)		
1= light green 2= medium green 3= dark green 4= very dark green		
____ Leaf Sheath Pubescence (Rate on scale from 1 = none to 9 = like peach fuzz)		
____ Marginal Waves (Rate on scale from 1 = none to 9 = many)		
____ Longitudinal Creases (Rate on scale from 1 = none to 9 = many)		

6. TASSEL:	Standard Deviation	Sample Size
____ Number of Primary Lateral Branches	_____	_____
____ Branch Angle from Central Spike	_____	_____
____. ____ cm Tassel Length (From top leaf collar to tassel tip)	_____	_____
____ Tassel Peduncle Length (From top node below flag leaf to bottom tassel branch)		
____ Tassel Central Spike Length (From top tassel branch to tassel tip).		
____ Branch Attitude from Central Spike (From main spike to tip of tassel branch). 1= Erect 2= Horizontal 3= Drooping		
____ Pollen Shed (Rate on Scale from 0 = male sterile to 9 = heavy shed)		
____ Anther Color (Munsell Code _____) 1= Green or Yellow (ex. Munsell Code 2.5GY 8/6 or 10Y 8.5/6) 3= Pink (ex. Munsell 2.5R 7/6 or 5R 5/6) 5= Red (ex. Munsell 2.5R 4/8) 7= Dark Red (ex. Munsell 10RP 4/8) 9= Purple (ex. Munsell 5RP 5/8)		
____ Glume Color (Munsell Code _____) 1= Green or Yellow (ex. Munsell Code 2.5GY 8/6 or 10Y 8.5/6) 3= Pink (ex. Munsell 2.5R 7/6 or 5R 5/6) 5= Red (ex. Munsell 2.5R 4/8) 7= Dark Red (ex. Munsell 10RP 4/8) 9= Purple (ex. Munsell 5RP 5/8)		
____ Bar Glumes (Glume Bands): 1 = Absent 2 = Present		
____ Bar Glume Anthocyanin Color (on the bottom 1/3 of glume; see UPOV Diagram; Note: the bar glume is listed as "present" if it is present and the ring is at least 50% closed) 1= Green or Yellow (ex. Munsell Code 2.5GY 8/6 or 10Y 8.5/6) 3= Pink (ex. Munsell 2.5R 7/6 or 5R 5/6) 5= Red (ex. Munsell 2.5R 4/8) 7= Dark Red (ex. Munsell 10RP 4/8) 9= Purple (ex. Munsell 5RP 5/8)		

7a. EAR (Unhusked Data):

- ___ Silk Color (3 days after emergence) (Munsell code _____)
 1= Green or Yellow (ex. Munsell Code 2.5GY 8/6 or 10Y 8.5/6)
 3= Pink (ex. Munsell 2.5R 7/6 or 5R 5/6)
 5= Red (ex. Munsell 2.5R 4/8)
 7= Dark Red (ex. Munsell 10RP 4/8)
 9= Purple (ex. Munsell 5RP 5/8)
- ___ Fresh Husk Color (25 days after 50% silking) (Munsell code _____)
- ___ Dry Husk Color (65 days after 50% silking) (Munsell code _____)
- ___ Position of Ear at Dry Husk Stage: 1 = Upright 2 = Horizontal 3 = Pendent
- ___ Husk Tightness (Rate on scale from 1 = very loose to 9 = very tight)
- ___ Husk Extension (at harvest): 1 = Short (ears exposed) 2 = Medium (<8 cm)
 3 = Long (8-10 cm beyond ear tip) 4 = Very Long (>10 cm)

7b. EAR (Husked Ear Data):

Standard Deviation Sample Size

- ___·___ cm Ear Length _____
- ___·___ mm Ear Diameter at mid-point _____
- ___·___ gm Ear Weight _____
- ___ Number of Kernel Rows _____
- ___ Number of Kernels per Rows _____
- ___ Kernel Rows: 1 = Indistinct 2 = Distinct
- ___ Row Alignment: 1 = Straight 2 = Slightly Curved 3 = Spiral
- ___·___ cm Shank Length _____
- ___ Ear Taper: 1 = Slight 2 = Average 3 = Extreme

8. KERNEL (Dried):

Standard Deviation Sample Size

- ___·___ mm Kernel Length _____
- ___·___ mm Kernel Width _____
- ___·___ mm Kernel Thickness _____
- ___·___ % Round Kernels (Shape Grade) _____
- ___ Aleurone Color Pattern: 1 = Homozygous 2 = Segregating
 (Describe _____)
- ___ Aleurone Color (Munsell Code _____)
 1= White 2= Pink 3= brown 4= tan 5= red 6= bronze 7= purple
 8= pink-orange 9= pale yellow 10= buff 11= blue 12= clear
 13= variegated or other (specify _____).
- ___ Hard Endosperm Color (Munsell Code _____)
 1= White (ex. Munsell Code 5Y 9/1 or 2.5Y 8.5/2)
 2= Yellow (ex. Munsell Code 2.5Y 8/10 or 7.5YR 7/14)
 3= Other (specify _____)
- ___ Endosperm Type: 1 = Sweet (su1) 2 = Extra Sweet (sh2)
 3 = Normal Starch 4 = High Amylose Starch 5 = Waxy Starch
 6 = High Protein 7 = High Lysine 8 = Super Sweet (se)
 9 = High Oil 10 = Other _____
- ___·___ gm Weight per 100 Kernels (unsized sample) _____

9. COB: Standard Deviation Sample Size

- ___ . ___ mm Cob Diameter at mid-point _____
- ___ Cob Color (Munsell Code _____)
 - 1= White (ex. Munsell 5Y 9/1 or 2.5Y 8.5/2)
 - 2= Pink (ex. Munsell 2.5R 7/6 or 5R 5/6)
 - 3= Red (ex. Munsell 2.5R 4/8 or 10RP 4/8)
 - 4= Other (describe _____)

10. DISEASE RESISTANCE (Rate from 1 (most susceptible) to 9 (most resistant); leave blank if not tested; leave Race or Strain Options blank if polygenic):

A. Leaf Blights, Wilts, and Local Infection Diseases

- ___ Anthracnose Leaf Blight (*Colletotrichum graminicola*)
- ___ Common Rust (*Puccinia sorghi*)
- ___ Common Smut (*Ustilago maydis*)
- ___ Eyespot (*Kabatiella zeae*)
- ___ Goss's Wilt (*Clavibacter michiganense* spp. *nebraskense*)
- ___ Gray Leaf Spot (*Cercospora zeae-maydis*)
- ___ Helminthosporium Leaf Spot (*Bipolaris zeicola*) Race _____
- ___ Northern Leaf Blight (*Exserohilum turcicum*) Race _____
- ___ Southern Leaf Blight (*Bipolaris maydis*) Race _____
- ___ Southern Rust (*Puccinia polysora*)
- ___ Stewart's Wilt (*Erwinia stewartii*)
- ___ Other (Specify) _____

B. Systemic Diseases

- ___ Corn Lethal Necrosis (MCMV and MDMV)
- ___ Head Smut (*Sphacelotheca reiliana*)
- ___ Maize Chlorotic Dwarf Virus (MCDV)
- ___ Maize Chlorotic Mottle Virus (MCMV)
- ___ Maize Dwarf Mosaic Virus (MDMV) Strain _____
- ___ Sorghum Downy Mildew of Corn (*Peronosclerospora sorghi*)
- ___ Other (Specify) _____

C. Stalk Rots

- ___ Anthracnose Stalk Rot (*Colletotrichum graminicola*)
- ___ Diplodia Stalk Rot (*Stenocarpella maydis*)
- ___ Fusarium Stalk Rot (*Fusarium moniliforme*)
- ___ Gibberella Stalk Rot (*Gibberella zeae*)
- ___ Other (Specify) _____

D. Ear and Kernel Rots

- ___ Aspergillus Ear and Kernel Rot (*Aspergillus flavus*)
- ___ Diplodia Ear Rot (*Stenocarpella maydis*)
- ___ Fusarium Ear and Kernel Rot (*Fusarium moniliforme*)
- ___ Gibberella Ear Rot (*Gibberella zeae*)
- ___ Other (Specify) _____

11. INSECT RESISTANCE (Rate from 1 (most susceptible) to 9 (most resistant) Leave blank if not tested): Standard Deviation Sample Size

- ___ Banks Grass Mite (*Oligonychus pratensis*)
- Corn Earworm (*Helicoverpa zea*)
 - ___ Leaf-Feeding
 - ___ Silk Feeding: ___ . ___ mg larval wt. _____
 - ___ Ear Damage
- ___ Corn Leaf Aphid (*Rhopalosiphum maidis*)
- ___ Corn Sap Beetle (*Carpophilus dimidiatus*)

11. INSECT RESISTANCE (continued)

Standard Deviation Sample Size

Fall Armyworm (*Spodoptera frugiperda*)

___ Leaf-Feeding
 ___ Silk Feeding:
 ___ . ___ . ___ mg larval wt. _____ _____

___ Maize Weevil (*Sitophilus zeamaze*)
 ___ Northern Rootworm (*Diabrotica barberi*)
 ___ Southern Rootworm (*Diabrotica undecimpunctata*)

Southwestern Corn Borer (*Diatraea grandiosella*)

___ Leaf-Feeding
 ___ Stalk Tunneling: ___ . ___ . ___ cm tunneled/plant _____ _____

___ Two-spotted Spider Mite (*Tetranychus urticae*)
 ___ Western Rootworm (*Diabrotica virgifera virgifera*)
 ___ Other (Specify) _____

12. AGRONOMIC TRAITS:

___ Stay Green (at 65 days after anthesis)
 (Rate on a scale of 1 = worst to 9 = excellent)

___ . ___ % Dropped Ears (at 65 days after anthesis)

___ . ___ % Pre-anthesis Brittle Snapping

___ . ___ % Pre-anthesis Root Lodging

___ . ___ % Post-anthesis Root Lodging (at 65 days after anthesis)

___ . ___ Kg/ha Yield of Inbred Per Se (at 12-13% grain moisture)

13. MOLECULAR MARKERS: (0 = data unavailable; 1 = data available but not supplied; 2 = data supplied)

___ Isozymes ___ RFLP's ___ RAPD's ___ SSRs ___ SNPs ___ Other (Specify) _____

Characteristics of Isozyme Polymorphism: 1= Absent 2= Present

___ Acp1
 ___ Acp4
 ___ Adh1
 ___ Dia1
 ___ Dia2
 ___ Idh1
 ___ Idh2
 ___ Mdh1
 ___ Mdh2
 ___ Mdh3
 ___ Mmm
 ___ Mdh4
 ___ Mdh5
 ___ Mdh6
 ___ Pgd1
 ___ Pgd2
 ___ Pgi1
 ___ Pgm1
 ___ Pgm2
 ___ Phi1

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COMMENTS: (e.g., state how heat units were calculated, standard inbred seed source, and/or where data was collected. Continue in Exhibit D.)