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Certified Reference Materials

AOCS 0411-D2

Report of the certification process for

NP2171/NP2460 (5307)

Maize

Second Batch

OECD Unique Identifier

SYN-Ø53Ø7-1

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Abstract

This report describes the preparation and certification of the maize Certified Reference Material (CRM) AOCS 0411-D2 produced by AOCS Technical Services in 2019. The CRMs have been prepared by AOCS according to ISO 17034:2016 and are intended to serve as control material for third party testing of maize for transformation events. NP2171/NP2460 (5307) maize seed powder was provided by Syngenta Crop Protection, LLC and was prepared by grinding the bulk source at AVEKA, Inc., Woodbury, MN (an ISO 9001:2015-accredited facility). The NP2171/NP2460 (5307) maize seed powder was then aliquoted and packaged under a nitrogen gas environment at Illinois Crop Improvement Association (an ISO 17025:2017-accredited facility). The certified mass value of Event 5307 in NP2171/NP2460 (5307) maize was based on seed purity and with 95% confidence, it is at least 904 g/kg. Homogeneity testing was performed at Eurofins-GeneScan, New Orleans, LA (an ISO 17025:2017-accredited laboratory) using quantitative real-time PCR after the CRM AOCS 0411-D2 was bottled. Homogeneity results indicated CRM AOCS 0411-D2 is homogenous and were used to verify the presence of Event 5307 in this CRM. CRM AOCS 0411-D2 is available in 27-mL glass headspace vials. This CRM shall be stored dry in a sealed container at ambient or cooler conditions in the dark.

Acknowledgements

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Glossary

AOCS	American Oil Chemists' Society
Conventional Crop	Conventional counterpart means a related organism/variety, its components and/or products for which there is experience of establishing safety based on common use as food
Cycle threshold (Ct)	Number of PCR cycles required for the fluorescent signal to cross a threshold that exceeds background level
DNA	Deoxyribonucleic Acid is the linear, double-helix macromolecule that makes up the genetic material of most organisms
Detection Limit	Lowest level at which target DNA can be detected in a sample.
EC	European Commission
Genome	The full set of genes and associated DNA characteristic of an organism
GMO	Genetically modified/engineered organism: an organism in which the genetic material has been changed through modern biotechnology in a way that does not occur naturally by multiplication and/or natural recombination.
ISO	International Organisation for Standardisation
PCR	Polymerase Chain Reaction: technique used to determine whether a sample of plant tissue contains a particular DNA sequence. PCR relies on primer sets that bind to a particular target DNA sequence and a special DNA-copying enzyme (DNA polymerase) that exponentially amplifies the target sequence for identification and measurement.

Qualitative PCR	PCR methods that determine the presence or absence of a specific target DNA sequence at a particular level of detection
Quantitation Limit	Lowest level at which the amount of target DNA sequence in a sample can be reliably quantified
Quantitative PCR	PCR methods that estimate the relative amount of target DNA sequence in a mixture of DNA molecules
RSD_r	Relative standard deviation
SD	Standard deviation
Trait: NP2171/NP2460 (5307)	Line of maize, genetically engineered to be resistant to corn rootworm (*Diabrotica* spp.)

Introduction

Plant biotechnology is an extension of traditional plant breeding. It allows plant breeders to develop crops with specific traits including insect, disease, and herbicide resistance; processing advantages; and nutritional enhancement. An important component for identifying these new traits is a Certified Reference Material (CRM) created from leaf, seed, or grain containing the new trait as well as a CRM created from the conventionally bred matrix. The European Commission has mandated that from 18 April 2004, a method for detecting a new event derived from transgenic technology and Certified Reference Material must be available before the EC will consider authorization of a new crop derived from transgenic technology. Several nations outside Europe also require grain and ingredients to be labeled above a threshold level before accepting a shipment.

To meet the above regulatory requirements for GMO determination, CRM AOCS 0411-D2 was manufactured from maize seed according to ISO 17034:2016 and in accordance with EC No 1829/2003, EC No 641/2004 and EC No 619/2011. This CRM is available from AOCS.

Material Processing and Particle Size Analyses

The hemizygous NP2171/NP2460 (5307) maize seed used in the preparation of CRM AOCS 0411-D2 resulted from the cross of female non-transgenic NP2171 and male NP2460 (5307). The NP2171/NP2460 (5307) seed was first milled and analyzed for particle size distribution at AVEKA, Inc., Woodbury, Minnesota (an ISO 9001:2015-accredited facility).

Bulk seed received by AVEKA, Inc. from Syngenta Crop Protection, LLC was milled in a Fitzmill cryogenic hammermill using first a 690 µm screen. To further reduce particle size, this ground material was milled again under the same conditions using a 510 µm screen. The material was blended in a Patterson-Kelley V-blender, and after homogenization six samples taken at random were subject to particle size analyses using a Horiba LA-950 Light Scattering Particle Analyzer. For each sample, the particle size mean and range,

and the percentage of particles below a certain size were calculated (Table 1). On average, the particle size of CRM AOCS 0411-D2 was 153.34 ± 4.71 µm, and 90% of the particles (i.e. D90) were smaller than 317.05 ± 11.29 µm.

Table 1. Results of Particle Size Analyses of CRM AOCS 0411-D2 Conducted by AVEKA, Inc.

	Sample 1 (µm)	Sample 2 (µm)	Sample 3 (µm)	Sample 4 (µm)	Sample 5 (µm)	Sample 6 (µm)	Average (µm)	Standard Deviation (µm)
Mean	147.09	156.19	157.90	152.74	148.45	157.67	**153.34**	**4.71**
Range	1.00 - 592.39	1.00 - 592.39	1.00 - 678.50	1.00 - 517.20	1.00 - 592.39	1.00 - 592.39	N/A [(a)]	N/A
D10 [(b)]	15.58	15.01	15.85	16.52	16.39	16.48	15.97	0.61
D50 [(b)]	130.49	139.90	139.40	139.78	133.39	142.27	137.54	4.54
D90 [(b)]	304.57	326.03	329.18	312.41	304.45	325.64	**317.05**	**11.29**

[(a)] N/A = not applicable

[(b)] D10, D50 and D90 indicate that 10%, 50% or 90% of the particles, respectively, are smaller than size given in table

The particle size distribution for each of the samples analyzed is presented as a histogram, with the x-axis showing discrete size bins up to 678.50 µm (Figure 1). Figure 1-A represents the percentage of particles of a given size, and Figure 1-B represents the cumulative particle size distribution, which reflects the total percentage of particles smaller than a given size. For all samples analyzed, 100% of particles were ≤ 678.50 µm.

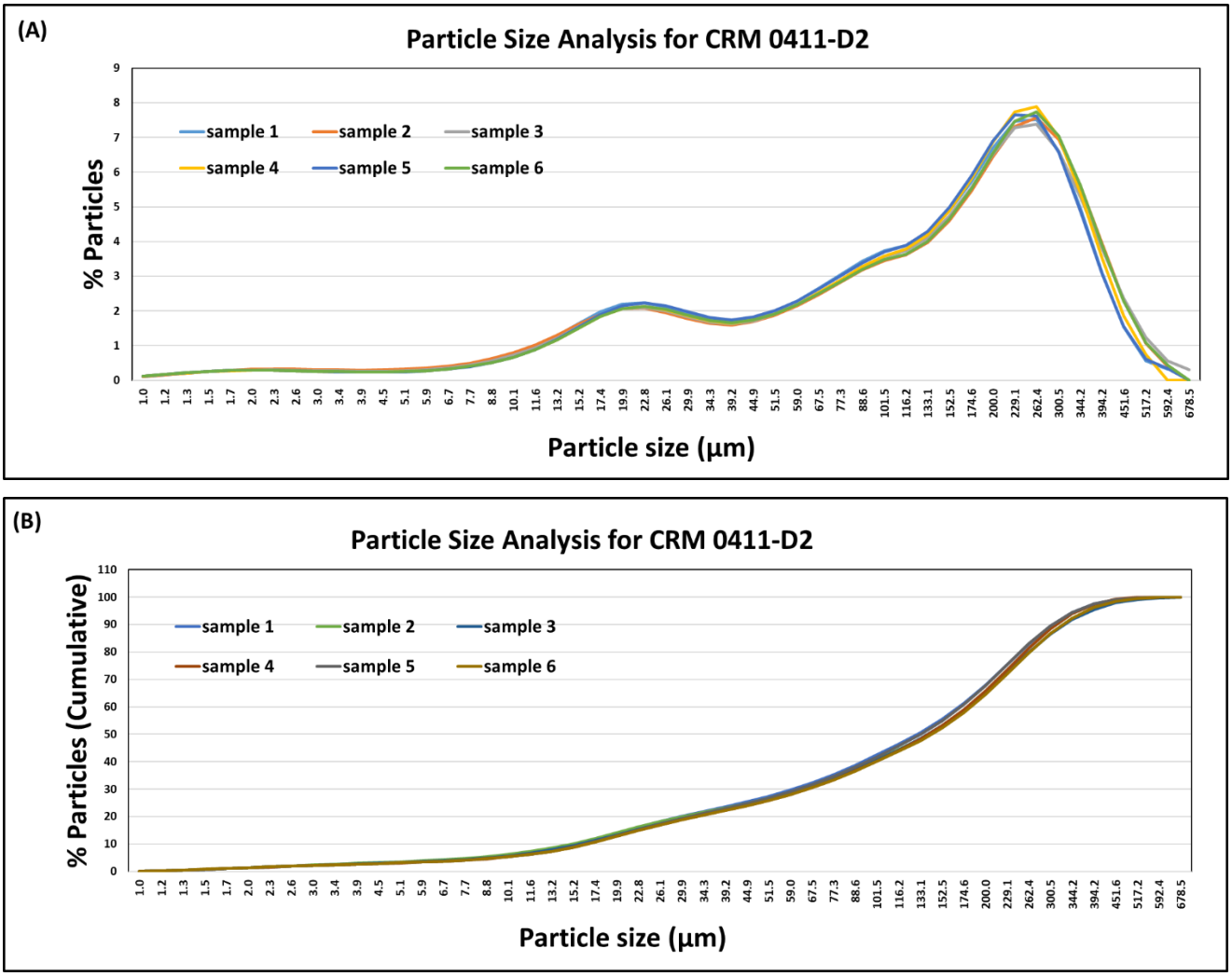

Figure 1. Particle size distribution plots. (A) Percentage of particles of a given size. (B) Cumulative distribution of particle sizes

Bulk NP2171/NP2460 (5307) maize seed powder for the production of CRM AOCS 0411-D2 was delivered to AOCS. It was then aliquoted and packaged in 27-mL glass headspace vials and sealed under a nitrogen gas environment at the Illinois Crop Improvement Association (an ISO 17025:2017-accredited facility).

Certified Value and Measurement Uncertainty

The genetic purity based on the presence of Event 5307 in NP2171/NP2460 (5307) maize was assessed by Syngenta Crop Protection, LLC. A total of 400 NP2171/NP2460 (5307) maize seeds were evaluated by qualitative 5307-specific real time PCR. The results

showed that 396 of the 400 seeds tested (99.0%) were positive for the presence of event 5307.

The statistical seed purity of NP2171/NP2460 (5307) maize was calculated using Seed-Calc8 (Remund *et al*., 2008) and corresponded to the lower bound of true % purity. Using a 95% confidence level, the true % purity of NP2171/NP2460 (5307) maize seed is at least 90.4%. Consequently, with 95% confidence, the true value is > 904 g/kg.

The measurement uncertainty (U_{CRM}) is the expanded uncertainty with a coverage factor of 2 and a confidence level of 95%. It is obtained by combining the uncertainties from the purity assessment ($u_{char,rel}$), the homogeneity assessment ($u_{bb,rel}$), the transport stability assessment ($u_{sts,rel}$) and the long-term stability assessment ($u_{lts,rel}$):

$$u_{CRM,rel} = \sqrt{{u_{char,rel}}^2 + {u_{bb,rel}}^2 + {u_{sts,rel}}^2 + {u_{lts,rel}}^2}$$

$$U_{CRM} = 2 \times u_{CRM,rel} \times 1000\ g/kg$$

When using an asymmetric uncertainty, the reported measurement uncertainty is truncated on the right side such that the value does not exceed 1000 g/kg. Consequently, the expanded measurement uncertainty for this CRM is +10 g/kg, -86 g/kg.

Homogeneity Testing

The material used for the production of CRM AOCS 0411-D2, NP2171/NP2460 (5307) maize, is 99.0% pure and is expected to be homogenous. After NP2171/NP2460 (5307) maize seed was ground and bottled as described above, ten samples of CRM AOCS 0411-D2 were randomly selected using the Microsoft Excel Random Number Generator function and were sent to Eurofins-GeneScan, New Orleans, LA (an ISO 17025:2017-accredited laboratory) for homogeneity testing using quantitative real-time PCR.

Homogeneity was assessed after bottling of AOCS 0411-D2 CRM using a 5307-specific, quantitative real-time PCR method (https://gmo-crl.jrc.ec.europa.eu/summaries/EURL-VL-04-17-VM.pdf). A total of 10 samples of CRM AOCS 0411-D2 maize were analyzed, and for each sample, 2 independent DNA extractions and quantifications were performed at Eurofins-GeneScan using a test portion of 1 gram. Extracted DNA was checked for

integrity by gel-electrophoresis and quantified prior to using it in quantitative real-time PCR. For each of the DNA extracts, all PCR reactions were done in triplicate.

The cycle threshold (Ct) values for the endogenous *adh1* maize gene and for Event 5307 were used to calculate the number of copies (cp#) for either target. Subsequently, the ratio between Event 5307 copy number and *adh1* copy number (5307 cp#/*adh1* cp#) was calculated and used to estimate within unit relative standard deviation ($\mathrm{RSD_w}$) and between-unit relative standard deviation ($\mathrm{RSD_b}$). Within-unit relative standard deviation ($\mathrm{RSD_w}$), between-unit relative standard deviation ($\mathrm{RSD_b}$) were calculated as:

Within-unit RSD: $RSD_w = \frac{\sqrt{MS_{within}}}{\bar{y}}$

Between-unit RSD: $RSD_b = \frac{\sqrt{\frac{MS_{between} - MS_{within}}{n}}}{\bar{y}}$

where,

$\mathrm{MS_{within}}$ within-unit mean square from an ANOVA
$\mathrm{MS_{between}}$ between-unit mean square from an ANOVA
$\bar{y}$ mean of all results of the homogeneity study
n mean number of replicates per unit

Table 2. The within-unit relative standard deviation (RSD_w) and the between-unit relative standard deviation (RSD_b) for vials of AOCS 0411-D2.

CRM	RSD_w [%]	RSD_b [%]
AOCS 0411-D2	8.7	6.7

The CRM will be determined to be homogeneous if the within-unit relative standard deviation ($\mathrm{RSD_w}$) and between-unit relative standard deviation ($\mathrm{RSD_b}$) are both ≤ 20%. Based on the quantitative real-time PCR analyses conducted, it was concluded that CRM AOCS 0411-D2 is homogenous (Table 2). These results are in agreement with homogeneity results from qualitative real-time PCR analyses and with the purity estimate for material 5307 maize calculated in the Certified Value and Measurement Uncertainty section above.

Trait Verification

The presence of the NP2171/NP2460 (5307) trait was assessed in the same ten CRM AOCS 0411-D2 samples that were analyzed for homogeneity using 5307-specific quantitative PCR analysis. Quantitative results were converted to qualitative data, and the results are presented in Table 3. In all instances Event 5307 was present.

Table 3. Qualitative results for the homogeneity and verification of CRM AOCS 0411-D2 as tested by Eurofins-GeneScan with a 5307-specific, quantitative PCR method

Sample	Event 5307 Presence
AOCS 0411-D2 10	Positive
AOCS 0411-D2 74	Positive
AOCS 0411-D2 75	Positive
AOCS 0411-D2 221	Positive
AOCS 0411-D2 327	Positive
AOCS 0411-D2 369	Positive
AOCS 0411-D2 376	Positive
AOCS 0411-D2 395	Positive
AOCS 0411-D2 422	Positive
AOCS 0411-D2 459	Positive

Stability

Time, temperature and light are regarded as the most relevant influences on the stability of CRM (Linsinger et al., 2001). The influence of light is mitigated by shipping and storing the vials in boxes, thus minimizing the possibility of degradation due to light. The influence of temperature is mitigated by storing the vials in a temperature-controlled room, and shipping vials at ambient temperature.

The effect of temperature and time are investigated.

A transport (short-term) stability study is conducted to assess the stability of maize CRM during transport. The temperature and time conditions in the study cover the typical conditions and the not so rare situations. The outcome of the study is considered transferable to other CRMs of similar property. Samples were subject to 3 different temperatures (4 °C (fridge), 25 °C (ambient), 60 °C (oven)) for 4 different durations (0, 1, 2, and 4 weeks). The study concluded that samples are stable at 4 °C (fridge) and 25 °C (ambient) for 4 weeks. The estimated uncertainty contribution from the transport stability study is 1.0%.

A long-term stability study is conducted to assess the stability of maize CRM during storage. Samples are stored at 25 °C (ambient) and the stability of the sample is monitored as long as the samples is available. The storage temperature study is 25 °C and the length of time to be studied is 10 years. The outcome of the study is considered transferable to other CRMs of similar property. In the initial 1-year stability study, samples were subject the storage condition for 4 different durations (0, 1, 3, 6 and 12 months). The study concluded that samples are stable at 25 °C (ambient) for 12 months. The estimated uncertainty contribution from long-term stability is 0.42%.

CRM stability over time will be analyzed by repeating the homogeneity study described above at a chosen shelf life of approximately every 24 months. The 24-month shelf life of CRM is chosen because the influence of analytical variation can be reduced by increasing the length of the stability study (Linsinger, et al., 2001).

The initial ratio between the number of copies of the GM event and the number of copies of the endogenous reference gene from the homogeneity study will establish the base line for the stability study. The ratio at each 24-month interval will be compared to the ratio established in the homogeneity study. The CRM will be determined to be stable if the variability of the ratios, determined as relative standard deviation (RSD) is $\leq$ 20%.

Stability of these CRMs has been listed as 2 years from the certification date. The materials were processed and are stored at ambient temperature, under nitrogen gas, in 27 -mL glass headspace vials. These materials are expected to be stable for longer than the estimated expiration date. The stability of the powder material will be reevaluated at time of expiration. If the samples are determined to be stable, the certificates will be extended.

References

AVEKA, Inc.; 2045 Wooddale Drive. Woodbury, MN 55125; Telephone : +1 651 730 1729; https://www.aveka.com/

Biosafety Clearing House Living Modified Organism (LMO) Registry http://bch.cbd.int/database/lmo-registry/

Eurofins-GeneScan; 2219 Lakeshore Drive Suite 400, New Orleans, LA 70122; Telephone: +1 504 846 2398; https://www.eurofinsus.com/food-testing/testing-services/gmo/

Illinois Crop Improvement Association, 3105 Research Road, Champaign, IL 61826; Telephone: +1 217 359 4053 Fax: +1 217 359 4075; www.ilcrop.com/

ISO 9001:2015, Quality Management Systems – Requirements

ISO 17025:2005 and ISO 17025:2017, General Requirements for the Competence of Testing and Calibration Laboratories

ISO 17034:2016 (E) General requirements for the competence of reference material producers

Linsinger, T., Pauwels, J., van der Veen, A. *et al.* Homogeneity and stability of reference materials. *Accred Qual Assur* **6,** 20–25 (2001). https://doi.org/10.1007/s007690000261

Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003R1829&from=en

Remund K, Simpson R, Laffont J-L, Wright D, and Gregoire S. Seedcalc8. 2008 https://www.seedtest.org/en/services-header/tools/statistics-committee/statistical-tools-seed-testing.html