Neue gentechnische Verfahren: Kommerzialisierungspipeline im Bereich Pflanzenzüchtung und Lizenzvereinbarungen.

«Im Auftrag des Bundesamtes für Umwelt (BAFU)»

«Sur mandat de l'Office fédéral de l'environnement (OFEV)»/»Su mandato dell'Ufficio federale dell'ambiente (UFAM)»/»Commissioned by the Federal Office for the Environment (FOEN)»

UPDATE: Dezember 2020

1. Welche Pflanzen, die mit Hilfe der neuen gentechnischen Verfahren entwickelt wurden:

befinden sich bereits im Anbau?

sind in der Entwicklungspipeline?

2. Lizenzvereinbarungen im Bereich der neuen gentechnischen Verfahren:

zwischen

Züchtungsunternehmen

Biotech-Unternehmen

Impressum

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Tabelle 1: Neue GV-Pflanzen, die bereits auf dem Markt sind und/oder in der Kommerzialisierungspipeline

(UPDATE Stand: Dezember 2020, Neue Einträge sind unterstrichen)

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Raps	Verschiedene Sorten, die unter der Marke Falco™ vertrieben werden.	Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz	***Cibus*** (USA)	Zulassung USA (seit 2004), Kanada (seit 2014) **Anbau**: USA seit 2015, Kanada seit 2018. 2020: Diskussionen um Nachweisverfahren und GMO-Status, siehe 121a, 122a	USA, Kanada (2011), Schweden (vor 2014), UK	1a,2a, 41a, 47a, 61a, 103a, 121a, 122a, 128a
Raps		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz	***Cibus*** (USA)	APHIS-Bescheid 2020 (unklar, ob sich Bescheid auf die nicht näher bestimmten HR-Resistenzen 2 oder 3 bezieht. HR 2 bei Cibus in Phase „Trait Validation“, HR 3 in „Trait Development“)	unklar	128a, 129a, 131a
Raps		Rapid Trait Development System (RTDS™), ODM	„Shatter tolerance“ (stabilere Hülsen, die bei der Ernte nicht so leicht zerbrechen)	***Cibus*** (USA)	Nach Angaben von Cibus in der Phase der „Trait Validation“. APHIS-Bescheid 2020.	ja	103a, 117a, 125a, 128a, 131a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Raps		Rapid Trait Development System (RTDS™), ODM	Ölqualität („Ultra high-oleic“), kombiniert mit Herbizidresistenz (Quelle: 104a)	***Cibus*** (USA)	Nach Angaben von Cibus in der Phase der „Trait Validation“. APHIS-Bescheid 2020	ja	103a, 104a, 117a, 126a, 128a, 131a
Raps		Rapid Trait Development System (RTDS™), ODM	Krankheitsresistenz (gegen *Sclerotinia*, Weissstängeligkeit)	***Cibus*** (USA)	Nach Angaben von Cibus in der Phase der „Trait Validation“. APHIS-Bescheid 2020	ja	103a, 117a, 128a, 130a, 131a
Raps		CRISPR-Cas9	Verbesserte Rapsschrot-Qualität (u. a. höherer Protein-Gehalt)	**Corteva** (USA)	APHIS-Bescheid 2020	ja	149a, 150a, 199a, 200a
Raps	Unklar, ob Trait C3007	CRISPR-Cas9 Yield10 Bioscience developed GRAIN, a novel gene discovery platform (200a)	Erhöhter Ölgehalt	**Yield10Bioscience** (USA), **Metabolix Oliseed** (CAN) Metabolix ist die kanadische Tochterfirma von Yield10Bioscience	APHIS-Bescheid 2020	Geplant ab 2021	75a, 78a, 118b, 119b, 188a, 189a, 200a, 202a
Lein		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz (Glyphosat)	***Cibus*** *(USA)*	Nach Angaben von Cibus in der Phase der „Trait Validation“. APHIS-Bescheid 2020	ab 2017 (ev. Kanada)	6a, 30a, 45a, 47a, 67a, 103a, 123a, 128a, 131a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Soja		Rapid Trait Development System (RTDS™), ODM	Krankheitsresistenz	***Cibus** (USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	103a, 128a
Soja		TALEN	Veränderte Fettsäurezusammen-setzung (*High oleic*) **Öl ist seit Anfang 2019 auf dem Markt in den USA** http://www.calyxt.com/first-commercial-sale-of-calyxt-high-oleic-soybean-oil-on-the-u-s-market/	***Calyxt Inc.*** (USA)	APHIS-Bescheid 2015. **Anbau** 2019: ca. 15 000ha, ca. 22 250ha sind unter Vertrag. 2020: ca. 40 460ha Anbau unter Vertrag (139a). Weitere High oleic Sorten in Entwicklung, gemäss Quelle 101a ist Phase II abgeschlossen und Phase III begonnen worden (*Advanced Field Tests, Application Tests & Commercial Value Validation*). Gesamte Ernte 2020 geht an ADM (132a)	Seit 2014 in den USA, Argentinien, seit 2018 Anbau, neue Sorten im Freisetzungs-versuch	15a, 16a, 17a, 39a, 43a, 44a, 49a, 63a, 82a, 83a 100a 101a, 113a, 114a, 132a. 133a, 139a
Soja		TALEN	Veränderte Fettsäurezusammen-setzung (*High oleic*) & niedrige Linolensäure (HOLL)	***Calyxt Inc.*** (USA)	APHIS-Bescheid 2015, Phase I der Entwicklung abgeschlossen. Kommerzialisierung ab 2023	USA	42a, 43a, 44a, 63a 101a, 113a, 114a, 133a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Soja		TALEN	Veränderte Fettsäurezusammen-setzung (*High oleic*) & niedrige Linolensäure (HOLL)	***Calyxt Inc.*** (USA)	APHIS-Bescheid 2020, Phase I der Entwicklung abgeschlossen. Kommerzialisierung geplant ab 2022	wahrscheinlich	135a, 136a, 138a
Soja		TALEN	Niedrige Linolensäure (HOLL)	***Calyxt Inc.*** (USA)	Kommerzialisierung ab 2026	unklar	133a
Soja		CRISPR	Veränderte Fettsäurezusammen setzung (*High-oleic*)	**Corteva** (USA)	„Next product in pipeline“ (nach Wachsmais)	unklar	108a, 199a, 200a
Soja		CRISPR	Erhöhter Proteingehalt, Soja soll in Aquakulturen als Fischfutter genutzt werden	**Amfora** (USA), **Corteva** (USA)	Forschung & Entwicklung. Unklar, ob sich APHIS-Bescheid von 2020 (146a,147a) auch auf diese Sojalinien bezieht	unklar	112b, 113b, 148a, 199a, 200a
Soja		CRISPR-Cas9	Erhöhter Protein- und Ölgehalt	**Corteva** (USA)	APHIS-Bescheid 2020	ja	146a, 147a, 199a, 200a
Soja		CRISPR	Verschiedene Traits: Resistenz gegen Südliche Stinkwanze (*Nezara viridula),* Herbizidtoleranz, Trockentoleranz	**DonMario Semillas** (ARG, BRA)	Kommerzialisierung geplant ab 2025	unklar	94a, 95a, 112a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Soja		TALEN	Hoher Fettsäuregehalt, als Palmölalternative	***Calyxt Inc.*** (USA)	Kommerzialisierung ab 2026	nein	133a
Soja		CRISPR	Nematodenresistenz	**Evogene** (ISR), **TMG – Tropical Melhoramento & Genética** (BRA)	APHIS-Bescheid 2020	geplant (Brasilien). „Evogene plans to import and move Edited SCN-Resistant Soybean within the United States“ (152a)	127b, 152a, 153a
Soja		CRISPR-Cas9	Veränderte Fettsäurezusammensetzung (*High-oleic*)	**ToolGen Inc.** (Süd-Korea)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	158a, 159a
Soja		CRISPR (Cas-Enzym undeklariert, patentiert von Inari)	Keine Angabe (*Confidential Business Information*)	**Inari Agriculture Inc.** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	172a, 173a
Mais		CRISPR (Cas-Enzym undeklariert, patentiert von Inari)	Keine Angabe (*Confidential Business Information*)	**Inari Agriculture Inc.** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	166a, 167a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Mais		CRISPR-Cas9	Veränderte Stärkezusammen-setzung (waxy corn)	**Corteva** (USA)	APHIS-Bescheid 2016, Kommerzialisierung geplant ab „end of decade“ (105a), ab 2020 (106a). 2020: superior field performance (field trials, 151a). Zeitpunkt Kommerzialisierung weiter offen	USA, ab 2016, Corteva is growing about 1,500 acres in research trials	3a,4a, 5a,48a, 64a, 65a, 105a, 106a, 107a, 151a, 199a, 200a
Mais		CRISPR-Cas9	Trockenheitstoleranz und Ertragsstabilität	**Corteva** (USA)	APHIS-Bescheid 2020. Zeitpunkt der Kommerzialisierung unklar	USA, ab 2016	7a,8a, 8b, 31a, 65a, 105a, 140a, 141a, 199a, 200a
Mais		CRISPR-Cas9	Höheres Ertragspotential (*enhanced yield potential*)	**Corteva** (USA)	APHIS-Bescheid 2020	unklar	142a, 143a, 199a, 200a
Mais		CRISPR-Cas9	Höherer Kornertrag (*increased grain yield*)	**Corteva** (USA)	APHIS-Bescheid 2020	unklar	144a, 145a, 199a, 200a
Mais		CRISPR	Pilzresistenz	**Evogene** (ISR), **Bayer Crop Science** (DEU)	Forschung & Entwicklung	geplant	119a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Mais		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz (*Herbicide resistance 1*)	***Cibus** (USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	128a
Mais		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz (*Herbicide resistance 2*)	***Cibus** (USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	128a
Mais		Rapid Trait Development System (RTDS™), ODM	Krankheitsresistenz (*Disease Toleance 2*)	***Cibus** (USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	128a
Reis		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz (*Herbicide resistance 1*)	***Cibus** (USA)*	Nach Angaben von Cibus in der Phase der „Trait Validation“. APHIS-Bescheid 2020 (unklar, ob sich diese Bescheid auf die nicht näher bestimmte Herbizidresistenz 1 bezieht)	unklar	6a, 67a, 103a, 124a, 128a, 131a
Reis		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz (*Herbicide resistance 2*)	***Cibus** (USA)*	Nach Angaben von Cibus in der Phase der „Trait Validation“. APHIS-Bescheid 2020 (unklar, ob sich diese Bescheid auf die nicht näher bestimmte Herbizidresistenz 2 bezieht)	unklar	6a, 67a, 103a, 127a, 128a, 131a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Reis		Rapid Trait Development System (RTDS™), ODM	Krankheitsresistenz	***Cibus** (USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	103a, 128a
Reis		Cisgenese	Salztoleranz	Texas A&M University (USA), **Nexgen Plants Pty Ltd** (AUS)	APHIS-Bescheid 2018, „GE-rice cultivars are in the early phases of development”	geplant	88a, 89a
Kartoffel		CRISPR-Cas9	Resistenz gegen Schwarzfleckigkeit („non-browning“)	**Simplot Plant Sciences** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant. Unklar, ob auch diese Kartoffel unter der Marke „Innate“ vertrieben werden soll	geplant	160a, 161a
Kartoffel		CRISPR-Cas9	Reduzierter Gehalt an Glykoalkaloiden (u. a. Solanin) **und** Resistenz gegen Schwarzfleckigkeit („non-browning“)	**Simplot Plant Sciences** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	geplant	197a, 198a
Kartoffel		CRISPR-Cas9	Reduzierter Gehalt an Glykoalkaloiden (u. a. Solanin)	**Simplot Plant Sciences** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	164a, 165a
Kartoffel		CRISPR-Cas9	Erzeugung von Selbst-inkompatibilität	**Simplot Plant Sciences** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	162a, 163a
Kartoffel		CRISPR-Cas9	Erhöhter Ertrag (Knollenbildung)	**Simplot Plant Sciences** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	168a, 169a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Kartoffel		CRISPR-Cas9	Verbesserte Lagereigenschaften bei kühlen Temperaturen (reduzierte vakuoläre Invertasen)	**Simplot Plant Sciences** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	170a, 171a
Kartoffel		Rapid Trait Development System (RTDS™),ODM	Resistenz gegen Kraut- und Knollenfäule	***Cibus*** *(USA)*	Nach Angaben von Cibus ist die Phase des Trait Development abgeschlossen	unklar	6a,67a, 103a, 128a
Kartoffel		Rapid Trait Development System (RTDS™),ODM	Herbizidresistenz	***Cibus*** *(USA)*	Nach Angaben von Cibus in der Phase der „Trait Validation“	wahrscheinlich	67a, 103a, 128a
Tomate		CRISPR (Cas-Enzym undeklariert, patentiert von Inari)	Keine Angabe (*Confidential Business Information*)	**Inari Agriculture Inc.** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	174a, 175a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Tomate	*Sicilian Rouge high GABA*	CRISPR-Cas9	Erhöhter Gehalt an Gamma-Amino-Buttersäure (GABA)	**Sanatech Seed** (JAPAN)	APHIS-Bescheid 2020. **Kommerzialisierung in Japan ab Frühjahr 2021.** On December 23, the Ministry of Health, Labour, and Welfare (MHLW) amended the handling procedures for products that are derived from the crossbreeding of genome edited varieties which have already been notified to MHLW. Developers of these products are no longer expected to undergo MHLW's consultation process. (201a)	wahrscheinlich	190a, 191a, 192a, 193a, 194a, 201a
Tomate		CRISPR-Cas9	Reduzierter Wuchs (für Urban Gardening/Agri-culture)	Zachary Lippman, Cold Spring Harbor Laboratory (USA)	APHIS-Bescheid 2020. „We believe these triple - determinate plants will be extremely desirable for future applications of tomato production in urban agriculture systems.“	unklar	195a, 196a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Weizen		TALEN	Erhöhter Ballaststoffgehalt	***Calyxt Inc.*** (USA)	APHIS-Bescheid 2018. Kommerzialisierung ab 2022	ja	50b, 63a, 79a, 80a, 81a, 93a, 113a, 114a, 133a
Weizen		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz 1	***Cibus*** *(USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	103a, 128a
Weizen		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz 2	***Cibus*** *(USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	103a, 128a
Weizen		Rapid Trait Development System (RTDS™), ODM	Krankheitsresistenz	***Cibus*** *(USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	103a, 128a
Hafer		TALEN	Kältetoleranz, Gluten-frei	***Calyxt Inc.*** (USA)	Kommerzialisierung ab 2026	nein	133a
Erdnuss		Rapid Trait Development System (RTDS™), ODM	Aflatoxin-frei	***Cibus*** *(USA)*	Nach Angaben von Cibus in der frühen Phase „Crop Platform Development“	nein	103a, 128a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Avocado		Genome Editing – ohne weitere Angaben	Unklar („*Confidential Business Information*“)	**GreenVenus** (USA). Firmenausgründung von Intrexon, die den nicht-bräunenden GreenVenus™-Salat entwickelt haben	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	180a, 181a, 182a
Avocado		CRISPR-Cas9	Non-browning	**J. R. Simplot** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	178a, 179a
Erdbeere		CRISPR-Cas9	Remontierende Erdbeere/mehr Ertrag durch 2x Blüte-/Fruchtbildung	**J. R. Simplot** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant	unklar	176a, 177a
Senf		Genome Editing – ohne weitere Angaben (vermutlich CRISPR)	Verbesserter Geschmack (Reduktion von Bitterstoffen, die Pflanze vor Frassfeinden schützen)	**Pairwise** (USA)	APHIS-Bescheid 2020. Kommerzialisierung geplant. „We plan to launch branded and co-branded fresh food products in retail stores and restaurants within the next few years.“	geplant	183a, 184a, 185a, 186a, 187a, 200a
Leindotter	ev. Trait C3007	CRISPR (Multiplexing)	Unklar („*Confidential Business Information*“), ev. veränderter/erhöhter Ölgehalt	**Yield10 Bioscience** (USA)	APHIS-Bescheid 2020	unklar	154a, 155a, 147b, 200a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Leindotter	Trait C3008a	CRISPR	Erhöhter Ölgehalt	**Yield10 Bioscience** (USA)**, Metabolix Oilseeds, Inc.** (CAN)	APHIS-Bescheid 2017	Ja, bislang im kleineren Masstab ab 2018 (USA)	49a, 50a, 51a, 75a, 78a, 96a, 118a, 200a
Leindotter	Traits C3008a, C3008b, C3009	CRISPR (Multiplexing) „the triple-edited Camelina plant lines are based on an oil biosynthesis pathway engineered directly into the plant – all based upon CRISPR genome editing.“ (Quelle: 102a)	Erhöhter Ölgehalt	**Yield10 Bioscience** (USA)**, Metabolix Oilseeds, Inc.** (CAN)	APHIS-Bescheid 2018	Ja, sollen mind. 2019 stattgefunden haben	75a, 76a, 77a, 78a, 96a, 102a, 119b, 200a
Salat	GreenVenus™ (Romana Salat)	Combination of genome editing technology (nicht näher spezifiziert) and traditional breeding techniques	Verlängertes Shelf-life, verringerte enzymatische Bräunungsreaktion (an verletzten Blättern)	**Intrexon** (USA)	APHIS-Bescheid 2019	USA, ab 2019	109a, 110a, 111a, 182a

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Alfalfa/ Luzerne		TALEN	Verbesserte Nährstoffzusammen-setzung, bessere Verdaulichkeit, hohe Erträge	***Calyxt Inc.*** (USA), **S&W Seed Company** (USA)	APHIS-Bescheid 2017, Kommerzialisierung ab 2021. Calyxt vermarktet den Trait, S&W wird das Saatgut auf den Markt bringen (137a)	wahrscheinlich	49a, 52a, 53a, 63a, 84a, 113a, 114a, 133a, 137a
Hanf		TALEN	Höhere Erträge	***Calyxt Inc.*** (USA)	Kommerzialisierung ab 2023. Hanf: Partnerschaft mit NRGene Ltd. (ISR), s. 134a		133a, 134a
Hanf		TALEN	Niedriger THC-Gehalt, breite Nutzungs-möglichkeiten (Fasern, Lebens-, Arzneimittel)	***Calyxt Inc.*** (USA)	Kommerzialisierung ab 2024. Hanf: Partnerschaft mit NRGene Ltd. (ISR), s. 134a		133a, 134a
Petunie		CRISPR-Cas9	Veränderte Blütenfarbe	**ToolGen Inc.** (Süd-Korea)	APHIS-Bescheid 2020	Unklar, Kommerzialisierung in den USA geplant	156a, 157a

Anmerkungen:

a) Verfahren – zur besseren Unterscheidbarkeit farbig markiert: ODM = Oligonukleotid-gerichtete Mutagenese / CRISPR = Clustered Regularly Interspaced Short Palindromic Repeats / ZFN = Zinkfinger-Nuklease-Verfahren / TALEN = Transcription activator-like effector nuclease / Intragenese / Cisgenese / RNAi = RNA-Interferenz / Meganuklease

b) *Unternehmen* (kursiv)= *Entwickler der Technologie;* **Unternehmen** (fett) **= Anwender**; (kursiv und fett) = ***Unternehmen & Entwickler***

c) Forschung & Entwicklung = angewandte Forschung (→ Kommerzialisierung wird wahrscheinlich angestrebt)

Das Unternehmen Corteva (das Unternehmen entstand 2019 als Ausgründung der DowDuPont Inc. Bedeutendste Tochter des Konzerns ist Pioneer) hat eine eigene CRISPR Webseite, um über die Nutzung des Verfahrens durch das Unternehmen zu informieren: https://crispr.corteva.com/

Quellen

1a= Ricroch, A. E., Hénard-Damave, M.-C. 2015: Next biotech plants: new traits, crops, developers and technologies for addressing global challenges. In: Critical Reviews in Biotechnology. Published online: 2 February 2015, ISSN; 1549-7801.

Download unter: www.ncbi.nlm.nih.gov/pubmed/25641327

2a= www.testbiotech.org/node/1433

3a= http://www.pioneer.com/home/site/about/news-media/news-releases/template.CONTENT/guid.1DB8FB71-1117-9A56-E0B6-3EA6F85AAE92

4a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-352-01_air_inquiry_cbidel.pdf

5a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-352-01_air_response_signed.pdf

6a= http://www.cibus.com/products.php

7a= www.nytimes.com/2015/11/15/magazine/the-crispr-quandary.html?_r=0

8a= www.technologyreview.com/s/542311/dupont-predicts-crispr-plants-on-dinner-plates-in-five-years/

9a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-321-01_air_inquiry.pdf

10a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-321-01_air_response_signed.pdf

11a= www.isaaa.org/gmapprovaldatabase/event/default.asp?EventID=177

12a= www.vistivegold.com/

13a= www.transgen.de/lebensmittel/1475.kartoffeln-aepfel-usa-gentechnik.html

14a= https://www.pioneer.com/home/site/about/news-media/news-releases/template.CONTENT/guid.8F199A5C-BCB5-82F4-3E0A-A4263F332FA7

15a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-071-01air.pdf

16a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-071-01air_resp.pdf

17a= http://www.calyxt.com/wp-content/uploads/2016/05/PR-5.24.16_Calyxt_Argentina_Soybean.pdf

18a= https://www.technologyreview.com/s/601285/here-come-the-unregulated-gmos/

19a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/DOW_ZFN_IPK1_052610.pdf

20a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/APHIS_response_DOW_ZFN_IPK1_030812.pdf

21a= http://www.nature.com/nature/journal/v459/n7245/full/nature07992.html

22a= http://www.calyxt.com/products/improved-quality-potato/

23a= https://www.technologyreview.com/s/536756/a-potato-made-with-gene-editing/

24a= http://www.capitalpress.com/Research/20160726/companys-gene-editing-pipeline-full-of-northwest-crops

25a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/16-090-01_air_inquiry_cbidel.pdf

26a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/16-090-01_air_response_signed.pdf

27a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/aphis_response_cellectis_potato.pdf

On September 23, 2016, APHIS announced the availability of the final Determination and Finding of No Significant Impact (FONSI) of Arctic® Fuji, developed by Okanagan Specialty Fruits, Inc.:

28a=https://www.aphis.usda.gov/aphis/ourfocus/biotechnology/sa_environmental_documents/sa_environmental_assessments/petition_extension_16-004-01p-osf-apple

The U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) extended deregulation to two lines of genetically engineered (GE) potatoes developed by **J.R. Simplot Company** for late blight resistance, low acrylamide potential, reduced black spot bruising, and lowered reducing sugars on October 28, 2016. APHIS previously reviewed and deregulated these GE traits in other GE potatoes:

29a= https://www.aphis.usda.gov/aphis/ourfocus/biotechnology/sa_environmental_documents/sa_environmental_assessments/simplot_x17_y9_ext

30a= http://www.cibus.com/press_release.php?date=040616

31a= https://www.pioneer.com/home/site/about/news-media/news-releases/template.CONTENT/guid.95ED9999-5719-1E79-8DA3-CE9A62C58CA2

32a= http://www.innatepotatoes.com/newsroom/view-news/usda-deregulates-additional-varieties-of-innate-second-generation-potatoes

33a= https://www.federalregister.gov/documents/2016/09/23/2016-22928/jr-simplot-company-availability-of-preliminary-finding-of-no-significant-impact-preliminary-plant

34a= http://www.cbc.ca/news/canada/prince-edward-island/potato-gmo-farmers-food-crops-1.3504446

35a= http://www.capitalpress.com/Nation_World/Nation/20161025/usda-clears-new-gmo-potato-variety

36a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/aphis_response_cellectis_potato.pdf

37a= http://www.vib.be/en/about-vib/plant-biotech-news/Documents/BackgroundReport_Potato_ENG.pdf

38a= http://www.tsl.ac.uk/news/new-potato-at-the-sainsbury-laboratory/

39a= http://www.cellectis.com/en/content/cellectis-plant-sciences-reports-generation-high-oleic-soybean-journal-plant-biotechnology-0

40a= https://one.oecd.org/document/ENV/JM/MONO(2016)5/en/pdf

41a= http://onlinelibrary.wiley.com/doi/10.1111/pbi.12444/full

42a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-071-01air_resp.pdf

43a= http://www.calyxt.com/wp-content/uploads/2016/11/11-15-16-U.S.-Soybean-Product.pdf

44a= http://bmcplantbiol.biomedcentral.com/articles/10.1186/s12870-016-0906-1

45a= http://www.producer.com/2016/03/field-trials-on-non-gm-tolerant-flax-coming-soon/

46a= http://s21.q4cdn.com/813101928/files/doc_factsheets/agriculture/Agriculture-Fact-Sheet_10.6.pdf

47a= https://www.cibus.com/pdfs/2017_Seed_Variety_Guide-Jim-Radtke.pdf

48a= https://biovox.eu/insights/detail/dupont-pioneer-rsquo-s-next-generation-of-waxy-corn-shows-the-green-side-of-crispr-cas9

49a= https://www.technologyreview.com/s/609230/these-are-not-your-fathers-gmos/

50a= http://ir.yield10bio.com/releasedetail.cfm?ReleaseID=1039116

51a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-166-01_air_response_signed.pdf

52a= http://www.calyxt.com/products/

53a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-038-02_air_response_signed.pdf

54a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-219-01_air_response_signed.pdf

55a= http://www.calyxt.com/calyxt-and-farmers-business-network-inc-partner-to-expand-grower-base-for-calyxts-identity-preserved-high-oleic-soybeans/

56a= http://www.calyxt.com/calyxt-and-sws-gene-edited-alfalfa-plant-designated-as-non-regulated-by-usda/

57a= http://www.calyxt.com/wp-content/uploads/2017/11/Calyxt-Investor-Presentation_November-2017.pdf

58a= http://www.bintjeplus.be/NL/HOME/tabid/7339/Default.aspx

59a= https://www.scientificamerican.com/article/genetically-modified-browning-resistant-apple-reaches-u-s-stores/

60a= https://agrow.agribusinessintelligence.informa.com/AG013374/BASFCibus-Clearfield-crops-advance

61a= https://www.grainews.ca/2018/02/08/new-non-gmo-canola-variety-for-the-market/

62a= https://geneticliteracyproject.org/2018/06/19/whats-in-the-crispr-drawer-for-farming-and-food/

63a= http://www.calyxt.com/wp-content/uploads/2018/10/Calyxt-Investor-Presentation-Oct-2018.pdf

64a= https://www.pioneer.com/home/site/us/agronomy/library/crispr-cas/

65a= http://www.ilsijapan.org/ILSIJapan/LEC/biotech/GenEd2017/06Gutterson.pdf

66a= https://s21.q4cdn.com/813101928/files/doc_downloads/DowDuPont-2017-Annual-Report.PDF

67a= https://www.cibus.com/crops.php

68a= https://www.gmwatch.org/en/news/latest-news/18575-gmo-potato-creator-now-fears-its-impact-on-human-health

69a= http://www.innatepotatoes.com/newsroom/view-news/j.r.-simplot-company-statement-on-caius-rommens-book

70a= http://www.potatogrower.com/2017/07/innate-acreage-low-in-canada

71a= https://ausveg.com.au/app/uploads/publications/Potatoes-Australia_June-July_Web.pdf

72a= https://www.ncbi.nlm.nih.gov/pubmed/29959585

73a= https://www.thepacker.com/article/gm-arctic-apples-heating-retail

74a= https://fruitgrowersnews.com/article/qa-with-developer-of-the-gmo-non-browning-arctic-apple/

75a= https://www.yield10bio.com/sites/default/files/YTEN%20Investor%20SlideDeck_WebSite_9_11_18.pdf

76a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-142-01_air_inquiry_cbidel.pdf

77a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-142-01_air_response_signed.pdf

78a= https://www.agritechtomorrow.com/article/2018/09/yield10-bioscience-with-dr-oliver-peoples/11000

79a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-038-01_air_inquiry_cbidel.pdf

80a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-038-01_air_response_signed.pdf

81a= http://www.calyxt.com/calyxt-harvests-high-fiber-wheat-field-trials/

82a= http://www.calyxt.com/calyxt-signs-agreement-with-american-natural-processors-to-crush-and-process-its-high-oleic-soybeans/

83a= http://www.calyxt.com/calyxt-inks-agreement-with-kemx-global-to-refine-high-oleic-soybean-oil/

84a= http://www.calyxt.com/calyxt-and-sw-seed-company-announce-milestone-in-alfalfa-seed-development-program/

85a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-298-01_air_inquiry_cbidel.pdf

86a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-298-01_air_response_signed.pdf

87a= http://bensonhillbio.com/2018/11/01/enabling-gene-editing-to-be-a-truly-enable-technology-part-iii/

88a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-286-01_01_air_inquiry.pdf

89a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-286-01_air_response_signed.pdf

90a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-076-01_air_inquiry_cbidel.pdf

91a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-076-01_air_inquiry_a1_cbidel.pdf

92a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-076-01_air_response_signed.pdf

93a= http://www.capitalpress.com/Nation_World/20180405/high-fiber-gene-edited-wheat-cleared-for-commercialization

94a= http://efarmnewsar.com/2018-09-07/don-mario-in-seven-years-we-will-be-launching-soybeans-obtained-by-nbt.html

95a= https://www.donmario.com/en/products/

96a= http://ir.yield10bio.com/news-releases/news-release-details/yield10-bioscience-announces-plans-its-2018-field-test-program

97a= http://www.dowagro.com/en-us/newsroom/pressreleases/2015/4/dow-agrosciences-arcadia-biosciences-and-bioceres-collaborate-to-develop-and-commercialize-soybean-traits

98a= https://arcadiabio.com/2015/12/02/dow-agrosciences-and-arcadia-biosciences-form-strategic-collaboration-to-develop-and-commercialize-corn-traits/

99a= http://www.annualreports.com/HostedData/AnnualReports/PDF/NASDAQ_RKDA_2016_2d51cabd96a0445cbb4977b00324d2cd.pdf

100a= https://www.transgen.de/aktuell/2724.usa-genom-editierte-sojabohnen-ohne-gentechnik.html

101a=https://calyxt.com/wp-content/uploads/2019/09/Calyxt-Investor-Presentation-2019-September-Cap-Conference.pdf

102a=https://www.yield10bio.com/crispr-gene-editing

103a=https://www.cibus.com/crops.php

104a=https://www.cibus.com/press-release.php?date=040119

105a= https://de.slideshare.net/OECD_ENV/nextgeneration-waxy-corn-a-flagship-case-of-sdn1nhej-genome-editing-via-crisprcas9

106a= https://seednews.com.br/edicoes/artigo/2920-gene-editing-and-the-return-to-basics-edicao-janeiro-2019

107a= https://americanfarmpublications.com/gene-editing-technology-keeping-eye-on-future/

108a= https://s23.q4cdn.com/505718284/files/doc_presentations/May-Investor-Day_Combined_FINALFINAL_050919.pdf

109a= https://investors.dna.com/2019-06-03-Intrexon-Announces-Advances-in-Non-Browning-GreenVenus-TM-Romaine-Lettuce

110a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-243-01_a4_air_cbidel.pdf

111a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-243-01_air_response_signed.pdf

112a= https://efarmnewsar.com/2019-03-20/don-mario-is-fully-operating-its-gene-editing-lab-stink-bugs-tolerance-most-advanced-program.html

113a= https://calyxt.com/wp-content/uploads/2019/09/Wells-Fargo-Conference-9-26-19.pdf

114a= https://calyxt.com/wp-content/uploads/2019/09/Calyxt-Investor-Presentation-2019-September-Cap-Conference.pdf

115a= https://www.agdaily.com/technology/time-convergence-agriculture-crispr-technology/

116a= https://www.globenewswire.com/news-release/2019/01/22/1703418/0/en/Yield10-Bioscience-Initiates-Early-Development-Program-in-Corn-to-Evaluate-Novel-Traits.html

117a= https://www.businesswire.com/news/home/20191106005350/en/Cibus-Achieves-Critical-Milestones-Non-GMO-Traits-Increase

118a= https://www.globenewswire.com/news-release/2018/07/02/1532387/0/en/Yield10-Bioscience-Begins-Field-Testing-of-Novel-Yield-Trait-Gene-C3003-and-Novel-Trait-Gene-C3008-in-Oilseed-Crops.html

119a= https://www.prnewswire.com/news-releases/evogene-amends-its-collaboration-agreement-with-bayer-to-include-genome-editing-targets-300885511.html

120a= https://www.wired.com/story/the-first-gene-edited-food-is-now-being-served/

121a= https://www.infogm.org/70547-cibus-canola-mysterious-origin-of-mutation?lang=fr

122a= https://www.greenpeace.org/static/planet4-eu-unit-stateless/2020/11/f7566127-gmo-status-su-canola_09112020.pdf

123a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-351-01-air-response-signed.pdf

124a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-348-01-air-response-signed.pdf

125a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-160-01_air_response_signed.pdf

126a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-04_air_response_signed.pdf

127a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-167-01_air_response_signed.pdf

128a= https://www.cibus.com/pipeline.php

129a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-08_air_response_signed.pdf

130a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-11_air_response_signed.pdf

131a= https://www.farmonline.com.au/story/6982571/exciting-new-non-gm-canola-traits-registered-in-us/

132a= https://www.bizjournals.com/chicago/news/2020/12/14/calyxt-sells-soybeans-archer-daniels-midland.html

133a= https://d1io3yog0oux5.cloudfront.net/_1a2a4f231df9b7f8f3da946e2d64399e/calyxt/db/358/3011/pdf/Calyxt_2020+Q4+INVESTOR+PRESENTATION+12+1+2020.pdf

134a= https://www.foodbusinessnews.net/articles/17481-calyxt-partners-with-genomics-data-company

135a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-066-01-air-cbidel.pdf

136a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-066-01-air-response-signed.pdf

137a= https://calyxt.com/calyxt-announces-commercial-agreement-with-sw-seed-company-to-deliver-improved-quality-alfalfa/

138a= https://calyxt.com/calyxts-high-oleic-low-linolenic-soybean-deemed-non-regulated-by-usda/

139a= https://calyxt.com/calyxt-achieves-2020-soybean-contracted-acreage-goal-of-100000-acres-2/

140a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-23_air_inquiry_a1_cbidel.pdf

141a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-23_air_response_signed.pdf

142a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-20_air_inquiry_cbidel.pdf

143a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-20_air_response_signed.pdf

144a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-12_inquiry_nocbi.pdf

145a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-12_air_response_signed.pdf

146a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-14_air_inquiry_nocbi.pdf

147a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-14_air_response_signed.pdf

148a= https://ussoy.org/soybean-farmers-benefit-from-nobel-prize-winning-research/

149a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-09_air_inquiry_a1_cbidel.pdf

150a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-09_air_response_signed.pdf

151a= https://www.nature.com/articles/s41587-020-0444-0

152a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-218-02_a2_air_inquiry_cbidel.pdf

153a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-218-02_air_response_signed.pdf

154a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-010-01_a1_air_inquiry_cbidel.pdf

155a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-010-01_air_response_signed.pdf

156a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-338-01_air_inquiry_cbidel_a1.pdf

157a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-338-01_air_response_signed.pdf

158a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-093-01-a1-air-inquiry-cbidel.pdf

159a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-093-01-air-response-signed.pdf

160a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-01_air_inquiry_cbidel.pdf

161a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-01_air_response_signed.pdf

162a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-34_air_inquiry_cbidel_a1.pdf

163a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-34_air_response_signed.pdf

164a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-02_air_inquiry_cbidel.pdf

165a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-02_air_response_signed.pdf

166a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-30_air_inquiry_cbidel.pdf

167a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-30_air_response_signed.pdf

168a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-03_air_inquiry_cbidel.pdf

169a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-03_air_response_signed.pdf

170a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-33_air_inquiry_a1_cbidel.pdf

171a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-33_air_response_signed.pdf

172a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-31_air_inquiry_a1_cbidel.pdf

173a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-31_air_response_signed.pdf

174a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-32_air_inquiry_cbidel.pdf

175a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-32_air_response_signed.pdf

176a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-05_air_inquiry_a1_cbidel.pdf

177a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-05_air_response_signed.pdf

178a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-35_air_inquiry_a2_cbidel.pdf

179a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-35_air_response_signed.pdf

180a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-163-01_air_inquiry_a1_cbidel.pdf

181a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-163-01_air_response_signed.pdf

182a= http://www.greenvenus.com/#news

183a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-07_air_inquiry_a3_a2_cbidel.pdf

184a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-07_air_response_signed.pdf

185a= https://thespoon.tech/pairwise-gets-greenlight-from-usda-for-crispr-engineered-mustard-greens/

186a= https://thespoon.tech/how-crispr-could-create-produce-that-lasts-longer-tastes-better-and-wont-make-pickers-bleed/

187a= https://pairwise.com/products/

188a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-163-02_air_inquiry_a1_cbidel.pdf

189a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-163-02_air_response_signed.pdf

190a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-140-01_air_CBIdel_a2.pdf

191a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-140-01_air_response_signed.pdf

192a= https://sanatech-seed.com/en/

193a= http://p-e-s.co.jp/tomato/high-gaba-tomatoes-monitor/

194a= https://www.freshplaza.de/article/9277142/wir-hoffen-dass-unsere-produkte-ihrer-gesundheit-nuetzen-werden/

195a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-149-01_air_inquiry_a1.pdf

196a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-149-01_air_response_signed.pdf

197a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-06_air_inquiry_cbidel.pdf

198a= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-168-06_air_response_signed.pdf

199a= https://www.genengnews.com/sponsored/mining-natures-diversity-for-novel-cas9-tools/

200a= https://www.genengnews.com/insights/redesigning-the-global-food-supply/

201a= https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=MHLW%20Updates%20Genome%20Editing%20Handling%20Procedures%20for%20Crossbred%20Progeny_Tokyo_Japan_12-21-2020

202a= https://yield10bioscienceinc.gcs-web.com/news-releases/news-release-details/yield10-bioscience-obtains-positive-response-usda-aphis-0

Änderungen im Gentechnik-Zulassungssystem der USA ab 2020

In den USA gibt es keine spezifische Gesetzgebung für gentechnisch veränderte Pflanzen. Die Zulassungspflicht orientiert sich nicht am Prozess der Herstellung, sondern an den Eigenschaften der Produkte. Gentechnisch veränderte Pflanzen, die keine offensichtlichen Risiken aufweisen, können ohne Zulassungsprüfung auf den Markt gelangen. Die Behörden Animal and Plant Health Inspection Service (APHIS) im US-Landwirtschaftsministerium (U.S. Department of Agriculture – USDA), die Food and Drug Administration (FDA) und die Environmental Protection Agency (EPA) haben unterschiedliche Zuständigkeiten bei Umweltrisiken, Lebensmittelsicherheit und Kennzeichnung: APHIS soll sicherstellen, dass sich Organismen (nicht nur GVOs) nicht zu Schädlingen (plant pests) entwickeln, die EPA prüft GV-Pflanzen mit Inhaltsstoffen, die gegen Schädlinge wirksam sind (ähnlich wie Pestizide), die FDA prüft die Lebensmittelsicherheit. Wenn ein Unternehmen/ein wiss. Institut einen Brief der APHIS erhält, der besagt, dass ihr Produkt nicht reguliert ist, bedeutet dies nicht automatisch, dass dieses Produkt ohne weitere Auflagen vermarktet werden kann. Im Anschluss an die APHIS, können auch die EPA oder FDA noch Regulierungsauflagen erlassen.

Mit der neuen SECURE-Richtlinie, die am 18. Mai 2020 im Federal Register veröffentlicht wurde (SECURE steht für *Sustainable, Ecological, Consistent, Uniform, Responsible, Efficient* = nachhaltig, ökologisch, konsistent, einheitlich, verantwortungsbewusst und effizient) wurden die APHIS-Richtlinien zur Überprüfung im Bereich der Biotechnologie zum ersten Mal, seit ihrer Einführung im Jahr 1987, umfassend überarbeitet.

Mehr Informationen: SECURE Rule Regulatory Changes

Zum Zeitplan der Umsetzung: Implementing the SECURE Rule

Die neue Richtlinie sieht vor, dass bestimmte Typen von bio-/gentechnologisch veränderten Pflanzen von den Regulierungsauflagen ausgenommen werden können. Die Begründung lautet: die gleiche Pflanze hätte auch durch konventionelle Züchtungstechniken entwickelt werden können; im Vergleich zu konventionell gezüchteten Pflanzen stellt sie wahrscheinlich kein erhöhtes (Pflanzenschädlings-)Risiko dar. Diese Ausnahmen sollen nur für Pflanzen gelten, für die – aus konventioneller Züchtung stammend – eine Art «history of safe use» vorliegt. Darüber hinaus sind Pflanzen von der Regulierung ausgenommen, die – betreffend ihren Produkteigenschaften (Kombination aus neuer Eigenschaft (trait) und Wirkmechanismus) – bereits zuvor von der APHIS als «non-regulated article» eingestuft wurden.

Unternehmen/Forschungseinrichtungen können bei der APHIS eine Bestätigung anfordern, dass ihr Produkt für eine Ausnahme qualifiziert ist und nicht den Bestimmungen in 7 CFR Teil 340 unterliegt. Der bislang praktizierte «Am I regulated?» Prozess wurde am 17. August 2020 eingestellt. Die im Rahmen dieses Prozesses erteilten Bestätigungen, dass es sich bei Produkt XY um einen «non-regulated articel» handelt, behalten weiter ihre Gültigkeit.

Konkret sind die folgenden bio-/gentechnologisch erzeugten Veränderungen in Pflanzen in Zukunft von jeglicher Regulierung durch die APHIS ausgenommen:

Herkömmliche (Trans-)Gentechnik: Für sie gilt künftig, dass eine einmal als sicher eingestufte gentechnische Veränderung nicht mehr neu zugelassen werden muss, wenn sie mit anderen Veränderungen kombiniert oder in anderen Sorten eingesetzt wird.

Neuen Gentechnik: Pflanzen können ohne Regulierungsauflagen vermarktet werden, wenn bei deren Herstellung Gene abgeschaltet wurden, ein Basenpaar geändert wurde oder das eingebaute Gen im Genpool der Art vorkommt. Zulassungsfrei sind auch alle gentechnischen Veränderungen, die theoretisch durch konventionelle Züchtung erreicht werden könnten. *Ob eine dieser Ausnahmen vorliegt, entscheidet allerdings nicht die für die Zulassungen zuständige Behörde APHIS, sondern das jeweilige Unternehmen selbst. Es kann sich bei APHIS durch eine Nachfrage rückversichern, muss dies aber nicht tun.*

A plant that contains a single modification of a type in one of the following three categories is exempt from regulation:

1. A change resulting from cellular repair of a targeted DNA break in the absence of an externally provided repair template; or
2. A targeted single basepair substitution; or
3. Introduction of a gene known to occur in the plant's gene pool, or a change in a targeted sequence to correspond to a known allele of such a gene or to a known structural variation present in the gene pool.

A plant that contains a plant-trait-mechanism of action (MOA) combination that APHIS has already evaluated under the previous or revised regulations and determined by APHIS not to be regulated.

Expansion of Exemptions

APHIS can expand the exemptions related to modifications that could otherwise be achieved through conventional breeding to ensure the regulations remain current with technology and science. Stakeholders can also request expansion through a process that provides public notice and comment.

Ein Wissenschaftler der US-amerikanischen Cornell University übt scharfe Kritik an den neuen Ausnahmeregeln und führt Beispiele auf, welche Pflanzen in Zukunft von der APHIS-Regulierung ausgenommen sein könnten:

Alliance for Science: Problematic provisions in new USDA rule for GE plants_20. October 2020

Tabelle 2: Neue GV-Pflanzen in der Forschungs- und Entwicklungspipeline

(UPDATE Stand: Dezember 2020, Neue Einträge sind unterstrichen)

→ Produkte, deren Kommerzialisierung wahrscheinlich ist, sind in der ersten Spalte grau hinterlegt

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Raps	Trait C3004	CRISPR	Erhöhter Ertrag	**Yield10Bioscience** (USA)	Yield10 produced its first canola lines containing the C3004 seed yield trait, one that is based on inserting a gene from Camelina to improve seed yield	unklar	118b, 119b, 200a
Raps		CRISPR	Krankheitsresistenz, Ertrag/Ertragsstabilität,weitere „Output Traits“	**Corteva** (USA)	„Broad R & D Investigations“	unklar	105a
Raps		ARCUS® genome-editing technology, Meganuklease	Raps(-öl) mit einem geringeren Gehalt an gesättigten Fettsäuren	**Cargill** (USA), *Precision BioScience* (USA)	Forschung & Entwicklung	nein	94b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Soja		CRISPR-Cas9	Hoher Proteingehalt über die Veränderung des NF-YC4-Gens	**Amfora** (USA)	Forschung & Entwicklung "Amfora plans to turn the soy into a high-density protein source for plant-based meat - eliminating the need for a capital-intensive concentration process - to produce a more environmentally friendly raw material."	unklar	200a
Soja	Ausgangssorte „Bert", zwei Linien 673-7-8, 673-7-12	CRISPR-Cas9 (SDN-1, Gen-Knock-out)	„Changes in Seed Composition"	University of Minnesota (USA)	APHIS-Bescheid 2019. Vermutlich Forschung, Freisetzungen geplant: University of Minnesota Agricultural Experiment Station, Saint Paul (Minnesota)	Ab 2019 oder 2020	96b, 97b
Soja	Ausgangssorte „Bert", eine Linie 687-5-10	CRISPR-Cas9 (SDN-1, Gen-Knock-out)	Veränderte Stiel-Länge	University of Minnesota (USA)	APHIS-Bescheid 2019. Vermutlich Forschung, Freisetzungen geplant: University of Minnesota Agricultural Experiment Station, Saint Paul (Minnesota)	Ab 2019 oder 2020	98b, 99b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Soja		CRISPR (CRISPR Cms1) CropOS™ platform: combines machine learning & big data with genome editing and plant biology	Ausgehend vom Sortenbestand von Schiller Genetics sollen entwickelt werden: „an expanded pipeline of new varieties including superior protein and amino-acid profile, improved feed digestibility, low trypsin inhibitor and other qualities“ (103b)	***Benson Hill*** (USA), **Schillinger Genetics/eMerge Genetics** (USA)	Forschung & Entwicklung. Auf seiner Homepage wirbt Benson Hill damit, dass sie als eine der wenigen Firmen das Non-GMO-Project-Label hätten.[1] Von Genome Editing ist überhaupt nicht mehr die Rede. Unklar, was aus diesem Projekt geworden ist.	nein	103b
Soja		CRISPR	Yield gene C3004, C3003	**Yield10 Bioscience** (USA), **Bayer Crop Science** (DE)	Forschung & Entwicklung „Under the amended research license, Bayer will have access to these new developments from Yield10's C3004 program and new advanced technology related to the C3004 trait and its potential to increase seed yield.“	unklar	119b, 129b, 147b, 200a

1 «We are among a handful of companies that are Non-GMO Project Verified at the seed-level for our products.» Auf der Seite des Non-GMO-Projects findet sich allerdings keinerlei Eintrag unter dem Namen «Benson Hill».

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Soja		CRISPR	Unklar („*Confidential business information*“)	University of Missouri, College of Agriculture, Food and Natural Resources, Division of Plant Science (USA)	APHIS-Bescheid 2020	geplant, Unigelände	160b, 161b
Soja		CRISPR-Cas9	Veränderte Blattform, erhöhtes Samengewicht	University of Missouri, College of Agriculture, Food and Natural Resources, Division of Plant Science (USA)	APHIS-Bescheid 2020	geplant, Unigelände	162b, 163b
Soja	Bert	CRISPR	Trocken- und Salztoleranz	USDA-ARS, Plant Science Research Unit (USA)	APHIS-Bescheid 2017, Kommerzialisierung unklar	geplant: Sand Plain Research Farm, Becker, Minnesota	49a, 54a
Soja		CRISPR	Herbizidresistenz	**Bioheuris** (ARG), **Santa Rosa Semillas** (ARG), **Grupo Don Mario** (ARG)	Forschung & Entwicklung. Kommerzialisierung geplant. Arbeit an 6 verschiedenen HR-Traits.	unklar	64b, 130b, 177b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Reis		CRISPR	Noch nicht spezifiziert	*Benson Hill Biosystems* (USA), **Rice Tec** (USA)	Forschung & Entwicklung. Auf seiner Homepage wirbt Benson Hill damit, dass sie als eine der wenigen Firmen das Non-GMO-Project-Label hätten. Von Genome Editing ist überhaupt nicht mehr die Rede. Unklar, was aus diesem Projekt geworden ist.	unklar	126b
Reis		CRISPR	Erhöhter Proteingehalt	**Amfora** (USA)	Forschung & Entwicklung	unklar	112b, 113b, 200a
Reis		CRISPR	Krankheitsresistenz, Ertrag/Ertragsstabilität,Trockentoleranz	**Corteva** (USA)	„Broad R & D Investigations“	unklar	105a
Reis		CRISPR	new rice varieties which deliver higher yields and are more resilient against biotic and abiotic stresses	**Corteva** (USA), International Rice Institute (IRRI) (PHL)	Forschung & Entwicklung	unklar	112b
Reis	Traits C4001, C4003	CRISPR	Verbesserte Photosyntheseleistung, erhöhte Pflanzenbiomasse	**Yield10Bioscience** (USA)	Forschung & Entwicklung	nein	75a, 119b, 200a

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Reis		CRISPR	Resistenz gegen Bakterienbrand (*Xanthomonas oryzae pv. oryzae*)	University of Missouri, College of Agriculture, Food and Natural Resources, Division of Plant Science (USA)	APHIS-Bescheid 2020	unklar	158b, 159b
Reis		TALEN	Resistenz gegen eine bakterielle Krankheit	State University of Iowa, Prof. Bing Yang (USA)	APHIS-Bescheid 2015, Forschung[d)]	Sommer 2014, Universitäts-gelände, Iowa	25b, 26b
Reis		CRISPR	Ertragssteigerung	Purdue University (USA), Chinese Academy of Sciences (China)[i]	Forschung[d)]	Ja, Shanghai, Hainan Island	77b, 78b
Weizen		CRISPR	Erhöhter Proteingehalt	**Amfora** (USA)	Forschung & Entwicklung	unklar	112b, 113b
Weizen		CRISPR Genome Editing auf Ebene von Mitochondrien und Organellen	Hybridweizen	***Napigen*** (USA)	Forschung & Entwicklung	unklar	110b, 111b, 200a
Weizen		CRISPR	Reduzierter Glutengehalt, weitere traits in Arbeit	**Arcadia Bioscience** (USA)	Forschung & Entwicklung. Soll im Rahmen des GoodWheat™-Labels (auch non gm/Tilling-Weizen) vermarktet werden	unklar	128b
Weizen		CRISPR	Krankheitsresistenz, Ertrag/Ertragsstabilität	**Corteva** (USA)	„Broad R & D Investigations“	unklar	105a

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Weizen		CRISPR	Hybridweizen	**Corteva** (USA)	_Zeitpunkt der Kommerzialisierung unklar. Keine aktuellen Informationen verfügbar	USA, ab 2016	7a, 8a, 72a
Weizen	Traits C4001, C4003	CRISPR	Verbesserte Photosyntheseleistung, mehr Pflanzenbiomasse	**Yield10Bioscience** (USA)	Forschung & Entwicklung	Nein	75a, 78a, 119b
Weizen		CRISPR, RNAi	Gluten“freier“ Weizen	Institute for Sustainable Agriculture in Cordoba (ESP)	Forschung & Entwicklung	Ja, Ort unklar “The GM wheat is currently being tested in 30 celiac patients from Mexico and Spain and so far the results are very encouraging.” (82b)	54b, 81b 82b, 117b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Weizen		CRISPR	Pilztoleranz. Im Rahmen des 2020 gestarteten Forschungsvorhabens PILTON sollen Weizenpflanzen mit verbesserter, multipler und dauerhafter Pilztoleranz durch neue Züchtungsmethoden entwickelt werden.	Träger: Gemeinschaft zur Förderung von Pflanzeninnovation e. V. (GFPi) Beteiligt: knapp 60 Züchtungs-unternehmen: neben Bayer, Syngenta, KWS, Weizen-, Raps-, Kartoffel- und Rebenzüchter sowie Biotechnologie-Startups und Südzucker.	Forschung & Entwicklung	geplant	170b, 171b
Hartweizen		CRISPR	Gluten“freier“ Hartweizen	Institute for Sustainable Agriculture in Cordoba (ES)	Forschung & Entwicklung “A number of companies have expressed interest in the technology and in using the material as it is or incorporating it into their breeding programs.” (81b)	unklar	81b
Braugerste		CRISPR-Cas9	Entwicklung einer Nacktgerste, Prüfung versch. Eigenschaften (u. a. Geschmack) im Brauprozess	Sainsbury Laboratory (GB), Oregon State University (USA)	Forschung[d)] APHIS-Bescheid 2020. Gerste wurde in GB entwickelt, soll in den USA freigesetzt und getestet werden	Ja, geplant (Oregon, USA)	152b, 153b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Leindotter	Trait C3007	CRISPR	Erhöhter Ölgehalt	**Yield10Bioscience** (USA)	Forschung & Entwicklung	unklar	75a, 78a, 119b, 200a
Leindotter		CRISPR	Erhöhter Ölgehalt (Omega-3-Fettsäure)	Rothamsted Reserach (GBR)	Forschung[d)] Neuer Freisetzungsantrag mit neuen Linien. Gemäss 147b existiert eine Technologie-vereinbarung zwischen Yield10Bioscience und Rothamsted R.	Ja, GBR seit 2018. Verlängert bis 2023	69b, 70b, 71b, 120b, 147b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Mais		CRISPR	Verkürzte Stängellänge. Other areas of focus include disease resistance, stress tolerance and plant growth and development.	**Bayer CropScience** (GER)	Forschung & Entwicklungs. 3 Projekte: 1. Advanced breeding used to introgress naturally occurring short stature characteristic into elite germplasm (Vitalia – Testanbau in Mexiko, 2020). 2. In collaboration with BASF, uses transgene to shorten internodes; enables applicability across wide-array of germplasm. 3. Genome editing: Multiple, elegant approaches to generate short-stature corn, creating potential for opportunities in multiple markets.	Unklar. Kommerz. ab 2028	173b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Mais		CROP OS™ platform combines machine learning and big data with genome editing (CRISPR) and plant biology	Ethanolgehalt (E+ ™)	***Benson Hill Biosystems*** (USA)**, Brownseed hybrids** (USA)	Forschung & Entwicklung. Auf seiner Homepage wirbt Benson Hill damit, dass sie als eine der wenigen Firmen das Non-GMO-Project-Label hätten. Von Genome Editing ist überhaupt nicht mehr die Rede. Unklar, was aus diesem Projekt geworden ist.	After four encouraging trial runs of E+™ corn in research and commercial-scale ethanol plants, Brownseed hybrids plans a major planting in 2020	104b
Mais		CRISPR	Verschiedene Traits, Ertragssteigerung, Trockentoleranz etc.	**Yield10 Bioscience** (USA)	The company has initiated an early development program in corn to evaluate novel seed yield and drought tolerance traits	unklar	115a, 116a, 119b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Mais, Soja, Weizen, Baumwolle, Raps		CRISPR	Verschiedene Traits	**Pairwise Plants** (USA), **Bayer Crop Science** (DEU)	Pairwise is researching how to use the technology to alter crops, like corn, soy, wheat, cotton and canola, exclusively for Bayer. If Pairwise is successful, Bayer will get the chance to commercialize the products, likely in about five to 10 years	unklar	131b, 200a
Mais		CRISPR	Resistenz gegen *Maize Lethal Necrosis Disease*	**Corteva** (USA), CIMMYT (MEX)	Forschung & Entwicklung Maissorten sollen für afrikanische Kleinbauern entwickelt werden	unklar	53b, 88b, 112b
Mais		CRISPR	Resistenz gegen Blattfleckenkrankheit	**Corteva** (USA)	APHIS-Bescheid 2018, Zeitpunkt der Kommerzialisierung unklar	unklar	65a, 90a, 91a, 92a, 105a

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Mais		CRISPR (SDN3 – CRISPR-Cpf1/Cms1)	Höherer Ertrag	***Benson Hill Biosystems** (USA)*	Forschung & Entwicklung, APHIS-Bescheid 2018. Auf seiner Homepage wirbt Benson Hill damit, dass sie als eine der wenigen Firmen das Non-GMO-Project-Label hätten. Von Genome Editing ist überhaupt nicht mehr die Rede. Unklar, was aus diesem Projekt geworden ist.	unklar	85a, 86a, 87a
Mais		Meganuklease	Veränderte Stärkezusammen-setzung	***Agrivida Inc.*** (USA)	APHIS-Bescheid 2015	unklar	23b, 24b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Mais		CRISPR (CRISPR-Cpf1/Cms1)	Photosynthetic efficiency trait, Ertragssteigerung	***Benson Hill Biosystems*** (USA), **Beck's** (USA)	Forschung & Entwicklung, anticipate filing a regulatory dossier with the USDA by 2021. Auf seiner Homepage wirbt Benson Hill damit, dass sie als eine der wenigen Firmen das Non-GMO-Project-Label hätten. Von Genome Editing ist überhaupt nicht mehr die Rede. Unklar, was aus diesem Projekt geworden ist.	Nein (Elitelinien: ja)	95b
Mais		CRISPR	SDN-1, Gen Knock Outs in Wee, ATM, ATR	Vlaams Instituut voor Biotechnologie (VIB) (BEL)	Forschung[d)] Freisetzungs-versuche seit 2017, erst seit 2018 im EU-GMO Register	Seit 2017-2019	72b, 73b, 114b
Mais		CRISPR	Forschung an Genfunktionen	Iowa State University (USA)	Forschung[d)] APHIS-Bescheid 2018	geplant	57b, 58b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Kartoffel		CRISPR	Vorhandene Abwehrebenen der Kartoffel verstärken, neue Abwehrmechanismen gegen diverse Schaderreger etablieren.	Verbundprojekt ADLATUS (gefördert vom BMEL)	Forschung & Entwicklung	geplant	172b
Kartoffel		CRISPR-Cas9	Non-browning	u. a. Consejo Nacional de Investigaciones Científicas y Técnicas/CONICET, Buenos Aires (ARG). Department of Plant Breeding, Swedish University of Agricultural Sciences, Alnarp (SWE)	Forschung[d)]	Seit 2020 in Argentinien	175b, 176b
Kartoffel		CRISPR	Veränderter Stärkegehalt	Lyckeby Starch AB (SWE)	Forschung & Entwicklung	Ja, seit 2019 bis 2023	123b, 124b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Kartoffel	Maris Piper, Agria	Cisgenese ev. RNAi	Resistenz gegen Kraut- und Knollenfäule, Kartoffelzysten-nematoden, geringere Anfälligkeit gegen Druckstellen	TSL Potato Partnership Project (The Sainsbury Laboratory), University of Leeds (GBR), **J. R. Simplot**, **BioPotatoes UK Ltd** (USA, GBR)	Forschung & Entwicklung. „We have now identified multiple lines that carry blight resistance genes and also genes for tuber quality (the nematode resistance constructs did not work well enough). We have submitted a proposal for follow on funding to continue the work for another 2 years (→ 2022), to identify a commercialisable transgenic line.”	Freisetzungs-versuche seit 2016. „We hope to be able to test advanced lines in field trials in 2019, 2020 and 2021, at 3 locations and identify the best line for commercial deployment.”	38a, 71a, 90b, 116b
Erbse		Genome Editing – ohne weitere Angaben	Verbesserter Geschmack	**Benson Hill** (USA)	APHIS-Bescheid 2020	unklar	150b, 151b
Tomate		CRISPR	Früchte lösen sich ohne Stielansatz beim Pflücken	University of Florida, Horticultural Sciences (USA)	Forschung[d)] APHIS-Bescheid 2018. Weiterer APHIS-Bescheid 2020 für neue Tomaten-Zuchtlinien (mit dem gleichen Trait)	unklar	59b, 60b, 148b, 149b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Tomate		CRISPR	Performing a proof-of-concept of a new method of rapid and efficient gene editing in a tomato plant	UC Davis Plant Biology Department (USA), **TechAccel** (USA)	Forschung & Entwicklung	geplant	74b
Tomate		CRISPR	Veränderung des Acylzucker-Stoffwechsels bei *Solanum lycopersicum* und *S. pennellii*	University of Michigan (USA)	Forschung[d)] APHIS-Bescheid 2020	geplant	144b, 145b, 146b
Alfalfa/Luzerne		Intragenese	Niedriger Ligningehalt	**J. R. Simplot** (USA)	Forschung & Entwicklung	unklar	1b, 91b
Alfalfa/Luzerne		CRISPR	Herbizidresistenz	**Bioheuris** (ARG)	Forschung & Entwicklung. Es sind 3 verschiedene HR-Traits in Arbeit.	unklar	177b
Sorghum		CRISPR	Improved disease resistance, nutritional value and enhanced resilience to biotic stresses	**Corteva** (USA), Donald Danforth Plant Science Center (USA)	Forschung & Entwicklung	unklar	112b
Sorghum, Hirse		CRISPR	Productivity and quality improvements	**Corteva** (USA), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) (IND)	Forschung & Entwicklung	unklar	112b
Sorghum		CRISPR	Herbizidresistenz	**Bioheuris** (ARG), **Tobin** (ARG)	Forschung & Entwicklung. Es sind 5 verschiedene HR-Traits in Arbeit.	unklar	177b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Cassava		CRISPR	Krankheitsresistenz	**Corteva** (USA), Donald Danforth Plant Science Center (USA), Virus Resistant Cassava for Africa (VIRCA)	Forschung & Entwicklung	wahrscheinlich (Kenia, Uganda)	67b, 68b, 112b
Sonnenblume		CRISPR	Krankheitsresistenz, weitere „Output Traits“	**Corteva** (USA)	„Broad R & D Investigations“	unklar	105a
Banane		CRISPR	Krankheitsresistenz	**Tropic Bioscience** (GBR)	With the new round of funding, the company, which was founded in 2016, will begin testing its new varieties globally.	geplant, u. a. in Costa Rica	133b, 200a, 174b
Banane		CRISPR	Verlängertes Shelf-life	**Tropic Bioscience** (GBR)	With the new round of funding, the company, which was founded in 2016, will begin testing its new varieties globally.	geplant	133b, 200a
Kaffee		CRISPR	Koffeinfreier Kaffee	**Tropic Bioscience** (GBR)	With the new round of funding, the company, which was founded in 2016, will begin testing its new varieties globally.	geplant	133b, 200a
Kohl	*Brassica oleracea*	CRISPR	Genetic regulation of Sulphur metabolism in Brassica oleracea	John Innes Center (GBR)	Forschung[d)]	2019 - 2021	115b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Hanf		CRISPR (CRISPR Cms1) CropOS™ platform: combines machine learning & big data with genome editing and plant biology	Research agreement: is designed to breed improved cultivars of *Cannabis sativa* – u. a. Ölgehalt	California Hemp Corporation (USA), ***Benson Hill Biosystems*** (USA), University of California, Davis (UC Davis) (USA)	Forschung & Entwicklung. Unklar, was aus dem Projekt geworden ist. Benson Hill wirbt nicht mehr damit, dass sie mit Genome Editing arbeiten.	geplant	100b, 101b, 102b
Tabak	*Nicotiana attenuata*	CRISPR	Lack of nectarine (superoxide dismutase) proteins in floral nectar	Max-Planck-Institut für chemische Ökologie, Jena (DEU)	Forschung[d)]	ab 2019 in den USA (Arizona, später auch Utah)	105b, 106b
Tabak	*Nicotiana tabacum*	CRISPR	Keine Angaben	**Altria Client Services** (USA). Dachverband grosser Tabakhersteller wie Philippe Morris	APHIS-Bescheid 2019 Forschung & Entwicklung	Geplant, incl. interstate movement of seeds, release of tobacco plants for growing und Saatgut-Export nach XX (Angabe geschwärzt)	108b, 109b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Tabak		CRISPR	Field test of the development of tobacco cv K326 plants derived (by self-pollination) from lines L157-5, L192-6, L226-2 and L259-1, with mutations in the sequence of SPL transcription factors, generated by CRISPR-Cas9, 2020 campaign	Agencia Estatal Consejo Superior de Investigaciones Cientificas, Instituto de Biologia Molecular y Celular de Plantas (ESP)	Forschung[d)]	Geplant, 1. März 2020 bis 31. Oktober 2020. Final Report veröffentlicht (166b)	125b, 166b
Tabak		Meganuklease	Geringerer Nikotingehalt	North Carolina State University (USA), **Precision Bioscience** (USA)	APHIS-Bescheid 2018, Forschung (unklar ob Entwicklung)	unklar	61b, 62b, 63b
Tabak	*Nicotiana glauca*	CRISPR-Cas9	Verschiedene Traits	Weizmann Institute of Science (ISR), Max Planck Institute for Chemical Ecology, Utah (USA)	Forschung[d)], APHIS-Bescheid 2020	Geplant, sowohl in Israel, als auch in den USA	154b, 155b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Tabak		CRISPR-Cas9	The tobacco plants to be released carry mutations (deletions and insertions) in different combinations of endogenous genes of the SPL family (SPL and FT-SPL lines), endogenous FT5 genes (FT and FT-SPL lines), endogenous MPO1 genes (MPO lines) or endogenous BBL genes (BBL lines). The mutations have been generated using the CRISPR / Cas9 system. These plants do not contain any transgene.	Instituto de Biología Molecular y Celular de Plantas, Agencia Estatal Consejo Superior de Investigaciones Científicas (ESP)	Forschung[d)]	01.03.2021 bis 31.10.2021. CTAEX Experimental field, Villafranco del Guadiana, Badajoz (950m^2)	165b
Orange		CRISPR	Toleranz gegen Zitruskrebs (*Xanthonomas citri*)	**Soil Culture Solutions, LLC (Soilcea)** (USA)	APHIS-Bescheid 2020	geplant	141b, 142b, 143b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Orange		TALEN /TAL code	Toleranz gegen Zitruskrebs (*Xanthonomas citri*). Patentanmeldung (Anspruch auf Resistenzgen) läuft (168b)	**2BladesFoundation** (USA)	Forschung & Entwicklung. "We are testing three different independent mechanisms of resistance that are effective against *Xanthomonas* pathogens in other systems. ... 3) We are using gene-editing techniques to alter a susceptibility gene which is known to confer bacterial resistance in other plants."	geplant	167b, 168b, 169b
Apfel		Cisgenese	Erhöhter Anthocyan-Gehalt	Stichting Dienst Land-bouwkundig Onderzoek (DLO) et al. (NLD)	Forschung[d)]	NL, 2016 - 2026	1b, 11b, 33b
Apfel		Cisgenese	Feuerbrandresistenz	ETH Zürich (CH), Agroscope (CH)	Forschung[d)]	Mit Auflagen in CH bewilligt 2016 - 2019	1b, 12b
Apfel		Cisgenese	Schorfresistenz	ETH Zürich (CH), Universität Wageningen (NLD)	Forschung[d)], teilweise Regulierung, APHIS 2012 (siehe Quelle 47b)	NL, 2011 - 2021	1b, 47b, 92b
Apfel, Birne		RNAi	Feuerbrandresistenz	**Okanagan Speciality Fruits** (USA)	Forschung & Entwicklung	unklar	27b, 75b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Apfel		RNAi	Schorfresistenz	**Okanagan Speciality Fruits** (USA)	Forschung & Entwicklung	unklar	27b, 75b
Pfirsich		RNAi	Resistenz gegen *Plum pox virus*	**Okanagan Speciality Fruits** (USA)	Forschung & Entwicklung	unklar	27b, 75b
Physalis		CRISPR	Verschiedene: Fruchtgrösse, Vorerntefruchtfall, Invasivität	Physalis Improvement Project, Boyce Thompson Institute (USA)	Forschung & Entwicklung. 2020 Start eines Community Science Project	ja	65b, 66b, 121b, 164b
Walnuss		Pfropfen auf GV-Unterlage	Resistenz gegen *Crown Gall disease*	Department of Pomology, University of California (USA)	Forschung und Entwicklung	unklar	43b, 2b, 93b, 122b
Himbeere, Brombeere		CRISPR	Verschiedene Konsumer-traits (u. a. Kirschen ohne Steine)	**Pairwise Plants** (USA)	Pairwise has entered a partnership with the USDA, N.C. State University and some other universities to study the genetics of caneberries (i.e. blackberries and raspberries)	Unklar. „We plan to launch branded and co-branded fresh food products in retail stores and restaurants within the next few years.“	131b, 132b, 186a, 187a, 200a
Erdbeere		Cisgenese, TALEN	Ertragssteigerung, verbessertes *Shelf life*, erhöhter Zuckergehalt, Krankheitsresistenz	**J. R. Simplot** (USA)	Forschung & Entwicklung Patentanmeldung (USA), 2018	Ja, ab 2015	38b, 39b, 76b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Weinrebe	*Vitis rotundifolia Muscadinia*	Cisgenese	Pilzresistenz, Kernlosigkeit	University of Florida (USA)	USDA-gefördertes Projekt, Kommerzialisierung geplant	Seit 2016	86b, 87b
Weinrebe		Intragenese	Erhöhter Anthocyan-Gehalt	University of Florida (USA)	APHIS-Bescheid 2012	wahrscheinlich	1b, 44b, 46b
Weinrebe		Pfropfen auf GV-Unterlage	Resistenz gegen die bakterielle *Pierce disease*	Department of Viticulture and Enology, University of California (USA)	Forschung & Entwicklung	Quelle 85b nennt gentechnisch veränderte Trauben, keine GV-Unterlagen	2b, 45b, 85b
	Acker-Hellerkraut (*Thlaspi arvense)*	CRISPR	Veränderter/erhöhter Ölgehalt im Samen	Illinois State University, Department of Biological Sciences (USA)	Forschung[d)] APHIS-Bescheid 2018. Erneuter Bescheid 2019. Erneuter Briefwechsel 2020, nachdem weitere Daten vorgelegt wurden: „… based on the information provided in your … letter … USDA does not consider the genome-edited pennycress lines … to be regulated pursuant to 7 CFR part 340...“	Geplant. „We are developing pennycress as an oilseed-producing cover crop to be grown throughout the U.S. Midwest Corn Belt.“	55b, 56b, 107b, 134b, 135b, 136b

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
	Acker-Hellerkraut (*Thlaspi arvense)*	CRISPR	Veränderter/erhöhter Ölgehalt im Samen (Kultur wird als Gründüngung über den Winter angebaut, Öl als Speiseöl, Bioenergie, Samen vermahlen als Tierfutter)	**CoverCress Inc.** (USA)	APHIS-Bescheid 2020.	Geplant	137b, 138b 139b 140b
	Rutenhirse, Switchgras (*Panicum virgatum* L.)	CRISPR	Nutzung als Bioenergiepflanze	University of Georgia, College of Agricultural & Environmental SciencesCenter for Applied Genetic Technologies (USA)	APHIS-Bescheid 2020. (Zeitgleich erging APHIS-Bescheid für gv-Rutenhirse, wahrscheinlich mit den gleichen Eigenschaften)	geplant	156b, 157b

Anmerkungen:

a) Verfahren – zur besseren Unterscheidbarkeit farbig markiert: ODM = Oligonukleotid-gerichtete Mutagenese / CRISPR = Clustered Regularly Interspaced Short Palindromic Repeats / ZFN = Zinkfinger-Nuklease-Verfahren / TALEN = Transcription activator-like effector nuclease / Intragenese / Cisgenese / RNAi = RNA-Interferenz / Pfropfen auf GV-Unterlage / Meganukleasen

b) *Unternehmen* (kursiv)= *Entwickler der Technologie;* **Unternehmen** (fett) **= Anwender**; (kursiv und fett) = ***Unternehmen & Entwickler***

c) Forschung & Entwicklung = angewandte Forschung (→ Kommerzialisierung wird wahrscheinlich angestrebt)

d) Reine Forschungsprojekte sind in dieser Tabelle nur aufgeführt, wenn, sofern bekannt, Freisetzungsversuche damit verbunden sind.

Quellen

1b= Ricroch, A. E., Hénard-Damave, M.-C. 2015: Next biotech plants: new traits, crops, developers and technologies for addressing global challenges. In: Critical Reviews in Biotechnology. Published online: 2 February 2015, ISSN; 1549-7801. Download unter: www.ncbi.nlm.nih.gov/pubmed/25641327

2b= Report of the OECD Workshop on Environmental Risk Assessment of products derived from New Plant Breeding Techniques (February 2014). Download unter: https://one.oecd.org/document/ENV/JM/MONO(2016)5/en/pdf

3b= www.testbiotech.org/node/1433

4b= www.producer.com/2016/01/herbicide-tolerant-flax-project-progressing/

5b= www.nytimes.com/2015/11/15/magazine/the-crispr-quandary.html?_r=0

6b= www.technologyreview.com/s/542311/dupont-predicts-crispr-plants-on-dinner-plates-in-five-years/

7b= www.transgen.de/lebensmittel/1475.kartoffeln-aepfel-usa-gentechnik.html

8b= https://www.pioneer.com/home/site/about/news-media/news-releases/template.CONTENT/guid.95ED9999-5719-1E79-8DA3-CE9A62C58CA2

9b= www.isaaa.org/gmapprovaldatabase/event/default.asp?EventID=177

10b= www.vistivegold.com/

11b= gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/NL/15/L01

12b= www.agroscope.admin.ch/aktuell/00198/05299/05494/index.html?lang=de&msg-id=59229

13b= www.ars.usda.gov/is/br/plumpox/

14b= www.miljodirektoratet.no/Global/dokumenter/Publikasjoner/Rapporter/Biosafety_Report_2013_01_Gen%C3%98k%20t%C3%B8rr%C3%A5te.pdf

15b= gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/SE/14/13820

16b= gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/ES/15/01

17b= www.genewatch.org

18b= www.morflora.com/?cp=584

19b= http://www.umu.se/ViewPage.action?siteNodeId=4510&languageId=1&contentId=259265

20b= https://www.buzzfeed.com/stephaniemlee/new-gmos-in-europe?utm_term=.gdG6ranDQ#.el6YplL62

21b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-238-01_air_inquiry_cbidel.pdf

22b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-238-01_air_response_signed.pdf

23b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-078-02_air_inquiry.pdf

24b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/15-078-02_air_response_final.pdf

25b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/air_isu_ting_rice.pdf

26b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/aphis_resp_isu_ting_rice.pdf

27b= http://www.okspecialtyfruits.com/about-osf/future-products/

28b= http://www.delmontefoods.com/frequently-asked-questions#GMO

29b= http://www.calyxt.com/products/lower-saturated-fat-canola-oil/

30b= http://www.calyxt.com/products/gluten-reduced-wheat/

31b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/SE/16/3494

32b= http://www.wur.nl/en/Expertise-Services/Research-Institutes/plant-research/DuRPh.htm

33b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/NL/15/L01

34b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/SE/14/13820

35b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/ES/15/01

36b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/ES/13/20

37b= http://www.nature.com/nbt/journal/v34/n4/full/nbt.3533.html

38b= http://www.transgen.de/aktuell/2565.freisetzungen-gentechnik-usa-eu.html

39b= http://events.cornell.edu/event/how_simplot_plant_sciences_plans_to_make_and_commercialize_genetically_modified_strawberries

40b= http://www.deutschlandfunk.de/gentechnik-vom-umkaempften-freilandversuch-zur-crispr-gerste.697.de.html?dram:article_id=353030

41b= http://cerealpath.eu/about-cerealpath/research-areas/

42b= http://cerealpath.eu/who-is-involved/programme-partners/

43b= http://www.sciencedirect.com/science/article/pii/S0168945202001644

44b= http://link.springer.com/article/10.1007/s00299-016-1974-2

45b= https://www.ncbi.nlm.nih.gov/pubmed/20565637

46b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/Grapevine_Inquiry_BR_response_042412.pdf

47b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/aphis_response_schouten.pdf

48b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/16-066-01_air_response_signed.pdf

49b= https://www.technologyreview.com/s/609230/these-are-not-your-fathers-gmos/

50b= http://www.calyxt.com/products/high-fiber-wheat/

51b= http://www.calyxt.com/products/herbicide-tolerant-wheat/

52b= http://www.calyxt.com/wp-content/uploads/2017/11/Calyxt-Investor-Presentation_November-2017.pdf

53b= http://crisprcas.pioneer.com/wp-content/uploads/2017/01/2016-09-28-PION-DuPont-CIMMYT-FINAL-2.pdf

54b= https://www.newscientist.com/article/2148596-genetically-modified-wheat-used-to-make-coeliac-friendly-bread/

55b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-036-01_a1_air_inquiry_cbidel.pdf

56b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-036-01_air_response_signed.pdf

57b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-110-01_air_inquiry_cbidel_a2.pdf

58b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-110-01_air_response_signed.pdf

59b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-051-01_a1_air_inquiry.pdf

60b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-051-01_air_response_signed.pdf

61b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-126-01_air_inquiry.pdf

62b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-126-01_air_support_cbidel.pdf

63b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/17-126-01_air_response_signed.pdf

64b= http://bensonhillbio.com/2018/05/10/new-companies-use-new-tools-to-create-new-choices-for-farmers/

65b= https://www.nature.com/articles/s41477-018-0259-x

66b= https://btiscience.org/our-research/bti-physalis-project/

67b= https://www.wired.com/story/european-ruling-could-slow-africas-push-for-crispr-crops/

68b= https://www.danforthcenter.org/scientists-research/research-institutes/institute-for-international-crop-improvement/crop-improvement-projects/virca?__sw_csrfToken=1BzDBRKLkDyY1azPvzYkJJkQW2PPJDw9

69b= https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/708560/gmo-camelina-oleic-acre-advice.pdf.pdf

70b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/GB/18/01

71b= https://www.gmfreeze.org/press-releases/defra-issues-a-free-pass-on-new-gm-technique/

72b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/BE/18/V8

73b= https://www.greenpeace.org/eu-unit/issues/nature-food/1260/unauthorised-gmo-field-trial-exposed-as-eu-takes-hands-off-approach-greenpeace/

74b= http://techaccel.net/2018/06/techaccel-announces-uc-davis-stair-grant-award-for-novel-gene-editing-approach/

75b= https://www.okspecialtyfruits.com/about-osf/future-products/

76b= http://www.freepatentsonline.com/20180092319.pdf

77b= https://geneticliteracyproject.org/2018/05/23/crispr-rice-increases-grain-yield-more-than-25-in-chinese-field-trials/

78b= http://www.pnas.org/content/115/23/6058

79b= http://www.emergtoplifesci.org/content/1/2/169

80b= https://www.bmel.de/SharedDocs/Downloads/Landwirtschaft/Pflanze/GrueneGentechnik/NMT_Stand-Regulierung_Anlage4-Aktualisierung.pdf?__blob=publicationFile

81b= https://www.globalrust.org/blog/francisco-barro-developer-gluten-free-wheat-deliver-keynote-address-bgri-technical-workshop

82b= http://www.isaaa.org/kc/cropbiotechupdate/newsletter/default.asp?Date=10/4/2017#15826

83b= https://www.theguardian.com/world/2010/aug/24/raid-destruction-french-gm-vines

84b= http://palatepress.com/2011/06/wine/will-grapegrowers-and-consumers-accept-gmo-wines/

85b= https://www.westernfarmpress.com/grapes/grape-vine-resistance-pierces-disease-within-decade

86b= https://vivo.usda.gov/display/NIFA-0225619-PROJ#time

87b= https://ageconsearch.umn.edu/bitstream/232281/2/1_Fonsah.pdf

88b= http://www.ilsijapan.org/ILSIJapan/LEC/biotech/GenEd2017/03Dhugga.pdf

89b= https://www.teagasc.ie/news--events/news/2018/gm-potato-environmental-.php

90b= https://gtr.ukri.org/projects?ref=BB%2FM017834%2F1

91b= https://www.ncbi.nlm.nih.gov/pubmed/17851774?dopt=Abstract

92b= http://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/NL/10/05

93b= http://www.berkeleybioeconomy.com/wp-content/uploads//2013/05/Transgenic%20rootstock%20based%20managementXX.pdf

94b= http://precisionbiosciences.com/cargill-leverages-new-technology-precision-biosciences-develop-ultra-low-saturate-high-oleic-canola-oil/

95b= https://bensonhillbio.com/2018/05/14/groundbreaking-new-trait-partnership-announced-to-provide-greater-choice-to-farmers/

96b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-077-02_air_inquiry_cbidel.pdf

97b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-077-02_air_response_signed.pdf

98b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-077-01_air_inquiry.pdf

99b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-077-01_air_response_signed.pdf

100b= https://bensonhill.com/2019/02/25/california-hemp-corporation-enters-sponsored-research-agreement-with-uc-davis-utilizing-benson-hills-cropos-to-optimize-breed-in-industrial-hemp/

101b= https://bensonhill.com/wp-content/uploads/2019/05/CRISPR-Nuclease-Portfolio-General.pdf

102b= https://bensonhill.com/wp-content/uploads/2019/03/AG_2019_MACHINE_LEARNING.pdf

103b= https://bensonhill.com/2019/03/19/benson-hill-acquires-schillinger-genetics-expanding-high-quality-soybean-options/

104b= https://www.finanzen.ch/nachrichten/aktien/benson-hill-biosystems-and-brownseed-genetics-forge-partnership-to-expand-corn-hybrid-choices-1028394696

105b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-248-01_a1_air_inquiry.pdf

106b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-248-01_air_response_signed.pdf

107b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/18-337-01_air_response_signed.pdf

108b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-101-01_air_inquiry_a1_cbidel.pdf

109b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-101-01_air_response_signed.pdf

110b= https://delawarebio.org/member-news/napigens-gene-editing-technology-and-the-future-of-food/

111b= https://napigen.com/

112b= https://crispr.corteva.com/our-promise-crispr-cas-corteva-agriscience/

113b= https://www.amforainc.com/copy-of-news-4-12-17-1

114b= https://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/BE/19/V1

115b= https://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/GB/19/52/01

116b= https://gtr.ukri.org/projects?ref=BB%2FM017834%2F1

117b= https://www.ncbi.nlm.nih.gov/pubmed/30813572

118b= https://www.globenewswire.com/news-release/2019/05/09/1821373/0/en/Yield10-Bioscience-Announces-First-Quarter-2019-Financial-Results.html

119b= https://www.yield10bio.com/Yield-Traits

120b= https://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/GB/19/R08/01

121b= http://cropbioengineering.iastate.edu/wp-content/uploads/2018/06/Day-1_Van-Eck.pdf

122b= https://link.springer.com/article/10.1007/s11295-017-1214-0

123b= https://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/SE/19/5614

124b= https://www.transgen.de/aktuell/2768.crispr-kartoffel-schweden.html

125b= https://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/ES/20/01

126b= https://www.prnewswire.com/news-releases/ricetec-and-benson-hill-collaborate-to-explore-new-technologies-for-rice-improvement-300859637.html

127b= http://www.evogene.com/press_release/evogene-and-tmg-announce-collaboration-to-develop-nematode-resistant-soybean-through-genome-editing/

128b= https://seekingalpha.com/article/4187488-arcadia-biosciences-speculative-pure-play-in-genome-editing-agricultural-space

129b= https://www.globenewswire.com/news-release/2019/08/19/1903507/0/en/Yield10-Bioscience-Expands-Research-License-with-Bayer-for-Evaluation-of-a-Novel-C3004-Yield-Trait-Gene-in-Soybean.html

130b= https://efarmnewsar.com/2019-09-10/bioheuris-or-how-to-fight-herbicide-resistant-weeds-with-gene-editing.html

131b= https://www.newsobserver.com/news/business/article232437938.html

132b= https://www.fb.org/news/toward-better-food-plants-the-promise-of-gene-editing

133b= https://www.fastcompany.com/40584260/this-startup-wants-to-save-the-banana-by-editing-its-genes

134b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-189-01_air_inquiry_cbidel.pdf

135b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-189-01_air_supporting_data_cbidel.pdf

136b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-189-01_air_response_signed.pdf

137b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-218-01_air_inquiry_cbidel.pdf

138b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-218-01_air_supporting_data_cbidel.pdf

139b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-218-01_air_response_signed.pdf

140b= https://www.covercress.com/

141b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-260-01_air_inquiry_cbidel.pdf

142b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-260-01_air_response_signed.pdf

143b= https://soilcea.com/

144b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-143-01_air_inquiry_a1.pdf

145b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-143-01_air_response_signed.pdf

146b= https://www.pflanzenforschung.de/de/pflanzenwissen/journal/den-tomaten-abgeguckt-substanz-zur-abwehr-von-frassfein-10575

147b= https://ir.yield10bio.com/static-files/cf303405-7952-494c-b7c8-fa017c8b0dd9

148b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-282-01-a3-air-inquiry-cbidel.pdf

149b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/19-282-01-air-response-signed.pdf

150b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-108-01-air-a1-cbidel.pdf

151b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-108-01-air-response-signed.pdf

152b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-113-01_air_inquiry.pdf

153b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-113-01_air_response_signed.pdf

154b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-044-01_air_inquiry_a1.pdf

155b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-044-01_air_response_signed.pdf

156b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-062-04_air_cbidel.pdf

157b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-062-04_air_response_signed.pdf

158b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-143-01_air_inquiry_a1.pdf

159b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-143-01_air_inquiry_a1.pdf

160b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-147-02_air_a2_inquiry_cbidel.pdf

161b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-147-02_air_response_signed.pdf

162b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-147-01_air_a1_inquiry_cbidel.pdf

163b= https://www.aphis.usda.gov/biotechnology/downloads/reg_loi/20-147-01_air_response_signed.pdf

164b= https://btiscience.org/our-research/bti-physalis-project-2/

165b= https://gmoinfo.jrc.ec.europa.eu/gmp_report.aspx?CurNot=B/ES/21/01

166b= https://gmoinfo.jrc.ec.europa.eu/finalreports/B-ES-20-01-Final-Report.pdf

167b= https://2blades.org/projects-and-technology/projects/citrus-canker/

168b= https://2blades.org/projects-and-technology/technology-patent-estate-and-development/

169b= https://2blades.org/2020/05/08/2blades-talens-gene-editing-tool-improves-disease-resistance-in-food-crops/

170b= https://pilton.bdp-online.de/

171b= https://pilton.bdp-online.de/wp-content/uploads/2020/09/PILTON_flyer.pdf

172b= https://www.bmel.de/SharedDocs/Pressemitteilungen/DE/2020/236-widerstandsfaehige-kulturpflanzen.html

173b= https://www.bayer.com/sites/default/files/2020-11/Crop_Science_R_D_Pipeline_Update_2020-02-13_Presentation.pdf

174b= https://www.telegraph.co.uk/technology/2020/06/08/norwich-firm-begin-field-trials-gene-edited-bananas/

175b= https://geneticliteracyproject.org/2020/02/04/field-trials-of-non-browning-crispr-edited-potatoes-begin-in-argentina/

176b= https://www.frontiersin.org/articles/10.3389/fpls.2019.01649/full?utm_source=F-NTF&utm_medium=EMLX&utm_campaign=PRD_FEOPS_20170000_ARTICLE

177b= https://www.bioheuris.com/en/what-we-do/

i Die Situation in China ist, auch was Freisetzungsversuche angeht, unübersichtlich.

Weitere Freisetzungsversuche mit Reis listet der folgende Artikel auf:
Metje-Sprink, J., Sprink, T., Hartung, F. 2019: Genome-edited plants in the field. Current Opinion in Biotechnology 2020, 61:1–6
https://doi.org/10.1016/j.copbio.2019.08.007

Für eine weitere Übersicht siehe auch: Modrzejewski, D., Hartung, F., Sprink, T., Menz, J., Kohl, C., Delventhal, R., Wilhelm, R. 2020: Übersicht über Nutz- und Zierpflanzen, die mittels neuer molekularbiologischer Techniken für die Bereiche Ernährung, Landwirtschaft und Gartenbau erzeugt wurden – marktorientierte Anwendungen. https://www.bmel.de/SharedDocs/Downloads/DE/_Landwirtschaft/Gruene-Gentechnik/NMT_Uebersicht-Zier-Nutzpflanzen.pdf?__blob=publicationFile&v=3

Eine Anlage gibt eine Übersicht zum regulatorischen Status der NMT in ausgewählten Drittstaaten:
https://www.bmel.de/SharedDocs/Downloads/DE/_Landwirtschaft/Gruene-Gentechnik/NMT_Stand-Regulierung_Anlage2.pdf?__blob=publicationFile&v=3

Zu Forschung im Bereich Genome Editing in China siehe die Artikelserie in Science: https://science.sciencemag.org/content/365/6452/420

Lizenzvereinbarungen und Kooperationen

zwischen Züchtungs- und Biotech-Unternehmen – Start-Ups – Forschungseinrichtungen/Universitäten

im Bereich der neuen gentechnischen Verfahren – landwirtschaftliche Anwendungen (2005 – 2020)

(UPDATE Stand: Dezember 2020, neue Einträge sind unterstrichen)

→ Die Einträge betreffend Landwirtschaft aus der CRISPR Licenses Dataverse (der *New York Law School*) sind in der Tabelle aufgenommen. Die Datensammlung enthält *"redacted and unreacted copies of IP license agreements in the CRISPR gene editing space, as well as press releases containing substantive information about confidential licenses." Einträge in der Datenbank reichen nur bis 2017.*

Eine Übersicht über die Patent"landschaft" bietet: https://www.ipstudies.ch/2020/10/2020-crispr-patent-landscape-where-do-we-stand/

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Tropic Bioscience	*BASF*	GEiGS™ (Gene Editing induced Gene Silencing)	2020-07	"Tropic Biosciences announces their research agreement with BASF to utilize Tropic's ground-breaking GEiGS™ (Gene Editing induced Gene Silencing) technology to develop traits to address growers' most critical challenges in protecting crops. The collaboration applies the Tropic Bioscience GEiGS™ platform within BASF's strategic crop varieties and utilizes BASF's expertise in the development of agricultural traits. GEiGS™ technology utilizes established genome editing tools to make precise and specific changes to only a few nucleotides within non-coding genomic locations of a host organism. These changes redirect RNA interference (RNAi, also Gene Silencing) activity of non-coding genes towards target genes, including those belonging to pathogens and pests. The approach does not depend on the introduction of foreign genes into the host genome."	75
University of Minnesota (USA)	*Calyxt (USA)*	Fast-TrACC	2020-04	Calyxt "has licensed a new method to help increase plant gene editing efficiency from the University of Minnesota. The method has the potential to reduce the time needed to edit plants from approximately one year to several months. This breakthrough, co-invented by Dan Voytas, Ph.D., the co-founder of Calyxt and the University of Minnesota Professor of Genetics, Cell Biology and Development (…) This new technology could help Calyxt bring consumer-desired products, like better tasting plant proteins, to the market faster."	72, 73, 74

Lizenzgeber	*Lizenznehmer*	*Verfahren*	*Jahr-Monat*	*Verwendungszweck*	*Quelle*
Broad Institute of MIT and Harvard	*Monsanto Company/BAYER Crop Science*	CRISPR-Cpf1	2020-03	"Monsanto Company announced that it has reached **a new global licensing agreement** with the Broad Institute of MIT and Harvard for the use of the novel CRISPR-Cpf1 genome-editing technology in agriculture. (…) Over the last year, Monsanto has licensed multiple genome-editing technologies – including a separate license from the Broad Institute for use of the CRISPR-Cas9 system in agriculture – to develop a leading portfolio of tools in this field. The intellectual property around the CRISPR-Cpf1 system is independent from the CRISPR-Cas patent estate, and this CRISPR-Cpf1 license provides Monsanto with another valuable tool for genome editing in this rapidly advancing field of science. Under the new agreement announced, the Broad Institute grants Monsanto a worldwide non-exclusive license for agricultural applications of the CRISPR-Cpf1 system. Additional terms of the agreement were not disclosed."	77
Corteva Agriscience (USA) *Broad Institute (USA)*	*Vilmorin & Cie (FRA)*	CRISPR-Cas9	2019-12	"This **non-exclusive license agreement** grants Vilmorin & Cie access to certain CRISPR-Cas9 patents covering genome editing tools for agricultural use. The license agreement covers all Vilmorin & Cie's research work and programs as well as potential commercial applications. Vilmorin & Cie will be able to deploy this technology for both its Field Seeds and Vegetable Seeds activities."	69, 70, 76
Benson Hill Biosystems (USA)	*Rice Tec (USA)*	CRISPR-Cms1	2019-06	"...announcing the **licensing agreement** for the use of Benson Hill's technologies as part of RiceTec's rice research and development operations."	62

Lizenzgeber	*Lizenznehmer*	*Verfahren*	*Jahr-Monat*	*Verwendungszweck*	*Quelle*
Corteva Agriscience (USA) *Broad Institute (USA)*	*Amfora (USA)*	CRISPR-Cas9	2019-04	"Amfora, a biotechnology company, announced it has reached a **non-exclusive research and commercial license agreement** with Corteva Agriscience™, the Agriculture Division of DowDuPont™, and the Broad Institute of MIT and Harvard. Through the agreement, Amfora will use intellectual property covering CRISPR-Cas9 and related gene editing tools to develop a portfolio of gene-edited crops with increased protein content."	64
Cold Spring Harbour (USA)	*Inari (USA)*	CRISPR-based tool for editing promoters	2019-04	"… announced today an exclusive licensing agreement with partner Inari, a company that is advancing plant breeding by tapping nature's genetic diversity. The technology developed by CSHL Professor and Howard Hughes Medical Institute Investigator Zachary Lippman allows Inari to tailor plant architecture and other traits in crops, improving productivity and quality to fit local environmental conditions."	65, 67
Massachusetts General Hospital (USA)	*Pairwise (USA)*	CRISPR	2019-03	"The agreement with MGH reflects Pairwise's commitment to finding and applying the right tools to deliver best-in-class solutions. Pairwise has the **exclusive license** to specific MGH CRISPR technology and will further develop applications for agriculture."	63

Lizenzgeber	*Lizenznehmer*	*Verfahren*	*Jahr-Monat*	*Verwendungszweck*	*Quelle*
Broad Institute (USA)	*Pairwise (USA)*	CRISPR-Cas9, -Cas12	2019-03	“The agreement with the Broad Institute gives Pairwise a license to the Cas9 and Cas12 (including both Cas12a/Cpf1 and Cas12b/C2c1) patent portfolios for use in plants and agriculture. The Broad Institute licenses are **non-exclusive** and adhere to the Broad Institutes’s ethical restrictions for agricultural use, which prohibit using CRISPR for gene drive, sterile seeds, or tobacco products for human use.“	63
University of California (USA)	*Inari (USA)*	Patents that describe key epigenetic pathways in plants and methods based on CRISPR for altering DNA methylation and gene regulation.	2019-02	“Inari, a company that is revolutionizing plant breeding by tapping natural genetic diversity, announced it has secured **exclusive patent licenses** for epigenetics from the University of California, Los Angeles (UCLA). The agreement, through UCLA's Technology Development Group, gives Inari access to tools that will positively influence crop performance without altering a plant's genetic code.”	66, 67
Broad Institute (USA)	*Vilmorin & Cie (FRA)*	CRISPR-Cpf1	2018-12	“..at the beginning of fiscal year 2018-2019, Vilmorin & Cie signed an agreement enabling it to broaden its range of technologies, by accessing the CRISPR genome editing technique, in order to use it in all its breeding work, both for Vegetable Seeds and Field Seeds. For this purpose, Vilmorin & Cie signed an agreement with the Broad Institute of MIT and Harvard biomedical and genomcis research center located in Cambridge in the United States. This agreement grants Vilmorin & Cie access to the technique known as CRISPR-Cpf1; it covers uses both for purposes of research and for potential commercial applications.”	69, 71

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Two Blades Foundation (2Blades) (USA)	*Epicrop Technologies Inc. (USA)*	TAL code technology	2018-11	**Non-exclusive licence agreement.** “We are pleased to be able to utilize this technology in our research t**o improve yields and stress tolerance in crops**” said Michael Fromm, CEO of Epicrop. “Research with this technology will help us to more efficiently optimize our conventional breeding methods **for improving epigenetics in crops**. Epigenetics is a form of biological information that has always been present in plants, and can be improved by plant breeding as we learn what features are most beneficial for higher stress tolerance and yields in the farmer’s field. It may seem surprising, to those more familiar with gene editing and other methods, that our epigenetic breeding methods produce plants that do not contain any changes to their genome sequence or introduce any foreign DNA sequences. Epigenetic improvements are analogous to a ‘software update’ that helps the plant’s natural genetics perform better without changing the ‘hardware’ of the genetic sequences.”	61
Broad Institute (USA)	*BASF (DEU)*	CRISPR-Cpf1	2018-10	“BASF has attained a **global, non-exclusive licensing agreement** with the Broad Institute of MIT and Harvard for the use of CRISPR-Cpf1 genome editing technology t**o improve products in agricultural** and industrial microbiology **applications**.“	57

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Corteva Agriscience™, Agriculture Division of DowDuPont™, Broad Institute (USA)	*J. R. Simplot (USA)*	CRISPR-Cas9 and related gene editing tools	2018-08	“Comprehensive intellectual property rights allow entities to apply scientific tools as widely as possible. To enable such access, Corteva Agriscience™ and Broad Institute have agreed on a joint **non-exclusive licensing framework for agricultural use**. The license to Simplot represents the first time that Corteva Agriscience™ and Broad Institute have jointly provided a license of CRISPR-Cas9 genome editing tools to an agricultural company.”	58
Corteva Agriscience™, Agriculture Division of DowDuPont™, Broad Institute (USA)	*Yield10Bioscience (USA)*	CRISPR-Cas9	2018-08	“For the **use of CRISPR-Cas9 genome-editing technology for crops**. The joint license covers intellectual property consisting of approximately 48 patents and patent applications on CRISPR-Cas9 technology controlled by the Broad Institute and Pioneer. Under the agreement, Yield10 has the option to renew the license on an annual basis and the right to convert the research license to a commercial license in the future, subject to customary conditions as specified in the agreement.”	59
Corteva Agriscience™, Agriculture Division of DowDuPont™, Broad Institute (USA)	*ICRISAT, The International Crops Research Institute for the Semi-Arid Tropics (India)*	CRISPR-Cas9	2018-04	“The **technology sharing** includes CRISPR-Cas gene editing, adapting transformation techniques to new crops, and applying knowledge of plant biochemical pathways with the goal of productivity and quality improvements for crops that feed millions of people. DuPont Pioneer, now part of Corteva Agriscience™, will provide access to intellectual property, material and know-how related to CRISPR-Cas and plant transformation.”	68

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Precision BioScience (USA)	*Cargill (USA)*	ARCUS® genome-editing technology	2018-02	"Together, the partners are using Precision's ARCUS® genome-editing technology **to further reduce saturated fat in canola oil**, putting Cargill at the forefront of a next-generation innovation. (…) This commitment to saturated fat reduction led to Cargill's partnership with Precision BioSciences in 2014. Since then, the two companies have worked together to lower saturate levels in canola oil, leveraging Cargill's expertise in gene identification, and Precision BioSciences' unique technology that edits the targeted genes."	60
Broad Institute (USA)	*Syngenta* (China, CH)	CRISPR-Cas9	2017-11	"Syngenta announced (...) it has attained a non-exclusive IP license from the Broad Institute of MIT and Harvard for **CRISPR-Cas9 genome-editing technology for agricultural applications**. CRISPR-Cas9 genome editing technology complements Syngenta's already robust plant breeding innovation toolbox. **Syngenta is applying this technology in multiple crops, including corn, wheat, tomato, rice and sunflower**."	48

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Broad Institute (USA) **+** *to jointly provide* ***non-exclusive licenses to foundational CRISPR-Cas9 intellectual property*** *under their respective control* ***for use in commercial agricultural research and product development***	*DuPont Pioneer (USA)*	CRISPR-Cas9	2017-10	"DuPont Pioneer and the Broad Institute of MIT and Harvard announced (...) that they have reached an agreement to **jointly provide non-exclusive licenses to foundational CRISPR-Cas9 intellectual property under their respective control for use in commercial agricultural research and product development**. These two major CRISPR-Cas9 license holders are coming together with the shared goal of enabling all entities wanting to apply the technology for agricultural applications with a full range of CRISPR-Cas9 tools. Such foundational intellectual property (IP) for CRISPR-Cas9 technology **will be freely available to universities and nonprofit organizations for academic research**. (…)"	55
Broad Institute (USA)	*Arcadia Bioscience Inc. (USA)*	CRISPR-Cas9	2017-09	"Arcadia Biosciences, Inc. (...), an agricultural technology company, announced (...) that it has signed a **global licensing agreement** with the Broad Institute of MIT and Harvard **for research use of the CRISPR- Cas9 genome-editing technology in agriculture**. The technology will enable Arcadia to accelerate the research and development of its agricultural nutrition and productivity traits."	51

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
ToolGen (USA)	*Monsanto (USA)*	CRISPR-technology platform	2017-08	“Monsanto and ToolGen, a biotechnology company specializing in genome editing, have reached a **global licensing agreement for the use of ToolGen’s CRISPR technology platform to develop agricultural products**. ToolGen is an early pioneer in gene editing research. The license provides Monsanto with access to ToolGen’s comprehensive suite of CRISPR intellectual property for use in plants. This agreement further expands Monsanto’s broad portfolio of gene-editing tools that can be used to develop improved and sustainable crops.”	54
DuPont Pioneer (USA)	*ERS Genomics*	CRISPR-Cas	2017-06	“DuPont Pioneer (DuPont) and ERS Genomics (ERS) announced a **technology license agreement** whereby **DuPont gains exclusive rights to the ERS patent portfolio covering CRISPR-Cas genome editing technology for all agricultural uses and applications in plants**. (...) **Pioneer is applying CRISPR-Cas as an advanced plant breeding tool to develop seed products for greater environmental resiliency, productivity and sustainability**. Pioneer has defined CRISPR-Cas guiding principles, which include helping enable others wanting to develop agricultural products using CRISPR-Cas by providing access to its IP, technology capabilities, infrastructure and scientific expertise.”	53

Lizenzgeber	*Lizenznehmer*	*Verfahren*	*Jahr-Monat*	*Verwendungszweck*	*Quelle*
Broad Institute (USA)	*BASF (Germany)*	CRISPR-Cas9	2017-03	"BASF (...) announced that it has reached a **global licensing agreement** with the Broad Institute of MIT and Harvard for the **use of CRISPR-Cas9 genome-editing technology to improve products in agricultural** and industrial microbiology **applications**."	47
Broad Institute (USA)	*Monsanto (USA)*	CRISPR-Cpf1	2017-03	"Monsanto Company announced that it has reached a new **global licensing agreement** with the Broad Institute of MIT and Harvard for the **use of the novel CRISPR-Cpf1 genome-editing technology in agriculture**. The CRISPR-Cpf1 system represents an exciting advance in genome-editing technology, because it has potential to be a simpler and more precise tool for making targeted improvements in a cell's DNA when compared to the CRISPR-Cas9 system."	52
Two Blades Foundation (2Blades) (USA)	*International Rice Research Institute (IRRI)* (Philippines)	TAL code technology	2016-12	"2Blades and the International Rice Research Institute (IRRI) have signed an agreement to further the cause of global food and nutrition security for the 3.5 billion people who depend on rice for more than 20% of their daily calories. The innovative **licensing agreement will enable IRRI to access leading-edge gene-editing technology, known as Transcription Activator Like (TAL) Effector Code and apply it to targets in rice genomes to increase micronutrient content in polished rice, particularly iron and zinc**. (…) Access to the TAL Code technology will enable IRRI to accelerate its on-going research into high-iron/ high-zinc rice varieties and actively advance viable, rice sector-based solutions to global food and nutrition security issues, including	49

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
				making improved rice varieties available more quickly to smallholder rice farmers. The agreement will positively impact a number of advanced breeding projects currently underway at IRRI.”	
Dow AgroSciences LLC (USA)	*Department of Environment and Primary Industries (DEPI)* via *Agriculture Victoria Services Pty Ltd.* (Australia)	EXZACT™ Precision Technology Platform (ZFN)	2016-12	“Dow AgroSciences announced that Agriculture Victoria's commercial arm, Agriculture Victoria Services Pty Ltd. ("AVS") is taking a commercial license to the EXZACT Precision Technology Platform to continue the development and commercialization of new forage grass varieties to benefit growers in Australia and around the world. ***The commercial license agreement aims at the development of forage grass varieties and related fungal endophytes produced using precision genome editing technologies.*** The license agreement acknowledges the advances Agriculture Victoria has made researching and developing innovative forage products using this gene editing platform that Dow AgroSciences has developed under an exclusive license and collaboration deal in plants with Sangamo BioSciences, Inc.”	46
Dow AgroSciences LLC (USA)	*Monsanto Company* (USA)	EXZACT™ Precision Technology Platform (ZFN)	2016-10	“For ***research and commercial development of new crop solutions*** across Monsanto Company’s research portfolio.”	2
DuPont Pioneer (USA)	*International Maize & Wheat Improvement Center/CIMMYT* (Mexico)	CRISPR-Cas	2016-09	“This collaboration with DuPont Pioneer will allow us ***to provide climate and disease resilient varieties*** more quickly to smallholder farmers in the developing world.” (CIMMYT Director General Martin Kropff)	3

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Broad Institute (USA)	*Monsanto Company* (USA)	CRISPR-Cas	2016-09	"The Broad Institute has decided to make available non-exclusive research and commercial licenses for the ***use of CRISPR technology in agriculture. But with important restrictions.*** These include: Gene Drive, Sterile Seeds, Tobacco."	4, 7
TargetGene Biotechnologies LTD (Israel)	*Monsanto Company* (USA) ← Beteiligung an	RNA-guided gene-editing techniques	2016-06	"Under the agreement, Monsanto has been granted an exclusive license to TargetGene's novel and proprietary "T·GEE" (Genome Editing Engine) platform ***to deliver continuous improvements in agriculture***. Monsanto has also established an equity position in the private Israel-based company."	5
Nomad Bioscience GmbH (D)	*Monsanto Company* (USA)	Gene Editing	2016-06	"… have announced a licensing agreement whereby Monsanto has obtained rights to apply Nomad's proprietary technology to its genome-editing projects ***aimed at enhancement of agricultural crops***. The licensed technology enables more efficient development of edited traits and may be applied across a broad range of genome-editing technologies and project types."	6

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Caribou Bioscience (USA)	*Genus* (USA)	CRISPR-Cas9-technology platform	2016-05	"Genus plc (...), a global pioneer in animal genetics, and Caribou Biosciences, Inc. (...), are pleased to announce a **multi-year strategic collaboration** where **Genus receives a worldwide, exclusive license to Caribou's leading CRISPR-Cas9 gene editing technology platform in certain livestock species**. (…) The agreement gives Genus exclusive access to Caribou's CRISPR-Cas9 technology **for the development of new traits in pigs, cattle and potentially other livestock species**. In addition to an upfront payment, Caribou is eligible to receive regulatory and commercial milestone payments as well as royalties on licensed product sales from Genus. Additional terms of the agreement were not disclosed."	56
Institute of Genetics and Developmental Biology (IGDB), *Chinese Academy of Sciences* (China) via *Plant Bioscience Limited* (PBL) (UK)	*Calyxt, Inc.* (USA)	TALEN	2015-12	"… signed a research collaboration and option to exclusive licenses with Plant Bioscience Limited (PBL) ***for certain new crop plants developed using gene editing*** by the Institute of Genetics and Developmental Biology (IGDB) of the Chinese Academy of Sciences in Beijing. *Plants with new traits in wheat, rice and corn are currently at various stages of development using gene-editing technology and include quality improvement and yield increase traits*."	10

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Arcadia Biosciences, Inc. (USA)	*Dow AgroSciences LLC* (USA)	EXZACT™ Precision Technology Platform (ZFN)	2015-12	„Arcadia Biosciences, Inc. (...) and Dow AgroSciences LLC (…) announce a strategic collaboration t***o develop and commercialize new breakthrough yield traits and trait stacks in corn***. The collaboration leverages Arcadia's leading platform of abiotic stress traits with Dow AgroSciences' enabling technology platforms, input traits, regulatory capabilities and commercial channels. (…) The collaboration will also utilize Dow AgroSciences' EXZACT™ Precision Technology Platform ***to enhance and accelerate the development of trait stacks.*** Dow AgroSciences has developed the EXZACT™ Precision Technology Platform under an exclusive license and collaboration agreement in plants with Sangamo BioSciences, Inc.“	17
Caribou BioSciences Inc. (USA) ⇄	*DuPont Pioneer* (USA) Kreuzlizenzierung	CRISPR-Cas	2015-10	“DuPont and Caribou have ***cross-licensed their respective patent portfolios***, with DuPont receiving exclusive intellectual property rights for CRISPR-Cas ***technology applications in major row crops***, and non-exclusive rights **in other agricultural and industrial bioscience applications**. … the alliance between DuPont and Caribou involves a multi-year ***research collaboration*** with scientists from the two organizations focused on ***enhancing the breadth, versatility and efficiency of the core CRISPR-Cas toolkit***. DuPont also has made a minority equity investment in Caribou to further strengthen the working relationship.”	9

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Dow AgroSciences (USA)	*Institute of Crop Sciences, Chinese Academy of Agricultural Sciences* (ICS-CAAS) (China)	EXZACT™ Precision Technology platform (ZFN)	2015-08	"Dow AgroSciences LLC (…) has entered into a collaboration agreement with the Institute of Crop Sciences of the Chinese Academy of Agricultural Sciences (ICS-CAAS). Under the agreement, Dow AgroSciences grants ICS-CAAS a royalty-free, non-transferable research and commercialization license for its proprietary ***EXZACT™ Precision Genome Editing Technology to be used in rice in China***. Dow AgroSciences and ICS-CAAS scientists ***will collaboratively develop an industry-leading rice genome editing technology platform.***"	34
Vilnius University, Institute of Biotechnology (Lithuania)	*DuPont Pioneer* (USA)	CRISPR-Cas9	2015-06	"… announced a technology license and ***research collaboration agreement*** with Vilnius University ***to further the technical and commercial utility of guided Cas9 genome editing technology.*** Under the agreement, DuPont receives an exclusive license to Vilnius University intellectual property *for all commercial uses, including in agriculture*."	8

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Dow AgroSciences (USA)	*Department of Environment and Primary Industries (DEPI)* via *Agriculture Victoria Services Pty Ltd.* (Australia)	EXZACT™ Precision Technology platform (ZFN)	2015-05	„The Department of Environment and Primary Industries (DEPI) of the State of Victory, Australia, through its commercial arm, Agriculture Victoria Services Pty Ltd. (AVS), strengthened a ***collaborative agreement to improve the performances of Australian canola varieties***. The project uses the EXZACT™ Precision Genome Editing Technology platform ***to continue developing new varieties of canola with enhanced performance*** designed to benefit farmers in Australia and globally. In addition, AVS will also use the EXZACT™ Precision Genome Editing Technology platform ***to enhance the genetics of crops important to Australian primary producers***.“	40
University of Minnesota (USA)	*Cellectis plant sciences, Inc.* (FRA)	CRISPR-Cas	2015-04	“Cellectis has signed an exclusive license agreement with the University of Minnesota that grants Cellectis the worldwide rights ***to use the technology covered by the patent rights of the family WO/2014/144155 entitled “Engineering Plant Genomes Using CRISPR/Cas Systems”***.”	14
Dow AgroSciences (USA)	*Chinese Academy of Agricultural Sciences* (CAAS) (China)	EXZACT™ Precision Technology platform (ZFN)	2015-03	“CAAS will negotiate a license to Dow AgroSciences’ proprietary EXZACT™ Precision Technology platform and toolkit and collaboratively develop a proposed ***research program with mutual development goals***. Dow AgroSciences and CAAS scientists will also work together to make sure that Dow AgroSciences’ expertise is best combined with CAAS’ expertise ***to accelerate rice research and product development in China***.”	15

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Two Blades Foundation (2Blades) (USA) ⇄	*Cellectis plant sciences, Inc.* (FRA) Kreuzlizenzierung	TAL Nuclease Technologies (TALEN)	2014-12	"...announced the execution of a non-exclusive cross-license agreement relating to TAL nuclease technologies. Pursuant to the agreement, 2Blades receives a license to TALEN™ technology ***for not-for-profit uses***, including use in 2Blades' ***humanitarian efforts to support subsistence farming***, and for certain ***commercial applications related to the disease resistance programs*** of 2Blades. In addition (…) Cellectis plant sciences receives a license under 2Blades' TAL Code technology related to nucleases ***for commercial uses in certain specified crop plants***. Cellectis plant sciences has an option ***to expand its license to additional crops***."	28

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Dow AgroSciences (USA)	*Department of Environment and Primary Industries (DEPI) of the State of Victoria* (Australia)	EXZACT™ Precision Technology platform (ZFN)	2014-08	"Dow AgroSciences (...) and the Department of Environment and Primary Industries (DEPI) of the State of Victoria, announced today several significant steps the organizations are taking together to advance science for agriculture. Dow AgroSciences has worked with DEPI through its commercial arm - Agriculture Victoria Services Pty Ltd. (AVS) - to apply the company's EXZACT™ Precision Technology Platform to improve the performance of canola varieties and is adding a new project. Collaborators since 2009, the organizations are now planning to enter into a seventh project together. The project builds on previous work from the collaboration, and is using the EXZACT™ Precision Genome Editing Technology Platform to continue developing new varieties of canola with enhanced performance designed to benefit farmers in Australia and around the world. This new research project will be based at DEPI's AgriBio research facilities in Bundoora. In addition, AVS has entered into a major **Research License Agreement with Dow AgroSciences to conduct research using the company's proprietary EXZACT Precision Genome Editing Technology Platform to enhance the genetics of crops of importance to Australian primary producers**."	50

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Dow AgroSciences (USA)	*Sigma-Aldrich Corporation* (USA)	Zinc finger nuclease (ZFN) reagents for use with EXZACT™ Precision Technology	2014-05	"Dow AgroSciences LLC (…) and Sigma-Aldrich Corporation (...) announced (…) an exclusive manufacturing license and supply agreement that will allow Sigma-Aldrich to manufacture and supply zinc finger nuclease (ZFN) reagents for use with EXZACT™ Precision Technology. Under the terms of the agreement, ***Sigma-Aldrich will be the exclusive provider of ZFN reagents for use in plants which will be available to Dow AgroSciences, its affiliates and licensees*** of the EXZACT Precision Technology ***to enable precision transformation, trait stacking and targeted mutagenesis in plants***."	19
Precision BioSciences (USA)	*Danziger Innovations LtD.* (USA)	Precision's Directed Nuclease Editor (DNE) gene editing technology	2014-03	„Danziger Innovations Ltd. and Precision BioSciences, Inc., (…) announced that they ***have successfully generated site-specific genome modifications in petunia and jasmine tobacco*** by combining Precision's Directed Nuclease Editor (DNE) gene editing technology with Danziger's MemoGene gene delivery system. This successful research effort was aimed at genetic control of flower color but researchers at Precision and Danziger believe that the approach can be used more broadly to address genome engineering challenges in plants that are recalcitrant to existing transformation methods without requiring the insertion of foreign DNA into the plant genome."	32

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Precision BioSciences (USA)	*Agrivida* (USA)	Directed Nuclease EditorTM (DNE) Technology	2014-03	"Precision BioSciences and Agrivida revealed today that they have entered into a ***trait development collaboration*** based on precise gene modifications made possible by Precision's Directed Nuclease EditorTM (DNE) Technology. The collaboration recently delivered the first modified genes that are the subject of Agrivida ***commercialization efforts in the area of animal nutrition***." (***Corn Traits for Improved Dairy and Beef Nutrition***).	11
Precision BioSciences, Inc. (USA)	*Nova Synthetix* (USA)	Precision's Directed Nuclease Editor (DNE) technology	2014-03	„Nova Synthetix and Precision BioSciences, Inc., (…) announced that they have initiated a joint research effort t***o generate non-GM, ricin-free castor plants*** using Precision's Directed Nuclease Editor (DNE) technology in combination with Nova Synthetix's proprietary plant transformation system. Scientists at Nova Synthetix and Precision also plan to utilize their joint capabilities to generate ***improved castor variants capable of producing user defined oil profiles*** for industrial, biofuel, and feed-directed applications. The companies believe that the successful development of this multi-year research effort will address a significant agricultural need and result in a castor plant that is safer and has far greater market utility."	31

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Cibus Global (USA)	*Nucelis* (will now become an independent operating unit of Cibus) (USA)	Rapid Trait Development System (RTDS)	2014-01	"Cibus Global (…) said it ***has acquired Nucelis***, which is working in fermentation and bio-based chemicals, including alternative squalane and D2 products. Established in 2010, Nucelis will now become an independent operating unit of Cibus, which employs about 100 people worldwide, and also includes Cibus US LLC and Cibus Europe B.V. ***Nucelis will continue to be the exclusive licensee to Cibus' Rapid Trait Development System (RTDS) technology*** in its key ***product areas of fermentation and bio-based chemicals***."	37
Cellectis plant sciences (FRA) ⇄	*Precision BioSciences* (USA) Kreuzlizenzierung	Meganuclease technology	2014-01	"Precision BioSciences, Inc. and Cellectis SA (…) announced that they have reached an agreement to settle patent litigation involving engineered I-CreI meganuclease technology. As part of the settlement, the companies will ***cross-license certain genome engineering patents*** and drop their ongoing lawsuits and patent challenges. This agreement provides clear freedom to operate for both companies in the engineered I-CreI meganuclease genome engineering field."	30

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Cellectis plant sciences (FRA)	*Bayer CropScience* (D)	Gene editing	2014-01	"Cellectis plant sciences (…) has signed two new agreements with Bayer CropScience (…) in the areas of seeds, crop protection and non-agricultural pest control, on gene editing in plants. The agreements extend the companies' existing partnership ***to introduce targeted modifications to selected plant genes and genomes***. (…) The first aim of this extended partnership is to collaboratively ***create commercial traits for the canola seed market*** using new technologies developed by Cellectis plant sciences. The second aim is to provide Bayer with access to technologies that enable the directed engineering of plant genomes, such as ***gene stacking and targeted mutagenesis***, for the development of improved crops."	18
Two Blades Foundation (2Blades) (USA)	*DuPont Pioneer* (USA)	TAL Effector Technology (TALEN)	2012-12	"2Blades continues broad license access to its award-winning TAL technology through a non-exclusive license to Dupont Pioneer f***or uses in certain crops***. Improvements to the technology will be granted back for 2Blades' humanitarian projects benefiting subsistence farming."	22
Iowa State University (USA)	*Cellectis plant sciences, Inc.* (FRA)	Inventions related to TAL effector-nucleases (TALENs™) and monomeric TALENs™	2012-10	"Cellectis (…), the genome engineering specialist, announces that it has signed two exclusive license agreements with the Iowa State University that grant Cellectis the worldwide right to use inventions related to TAL effector-nucleases (TALENs™) and monomeric TALENs™. These two exclusive licenses granted to Cellectis cover ***all uses of the TAL technologies in any field***."	26

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Two Blades Foundation (2Blades) (USA)	*Monsanto Company* (USA)	TAL Nuclease Technologies (TALEN)	2012-09	"2Blades announces the expansion of rights to Monsanto under our non-exclusive license, announced in April, 2012, for ***broader access to the TAL Code technology***. 2Blades will continue to receive a grant back of improvements to the technology for use in 2Blades' humanitarian projects."	43
Two Blades Foundation (2Blades) (USA)	*KWS SAAT AG* (D)	TAL Nuclease Technologies (TALEN)	2012-07	"Two Blades Foundation (2Blades) has completed a non-exclusive license agreement with KWS SAAT AG (KWS) for access to 2Blades' Transcription Activator Like (TAL) effector code technology ***for genome engineering in certain crops***. KWS will grant improvements in the technology back to 2Blades for subsistence farming applications."	42
Two Blades Foundation (2Blades) (USA)	*Bayer CropScience* (D)	TAL Nuclease Technologies (TALEN)	2012-05	"2Blades is pleased to announce completion of a non-exclusive license agreement with Bayer CropScience for the TAL code genome engineering technology. 2Blades will receive improvements to the TAL code for use in its subsistence farming applications."	44
Two Blades Foundation (2Blades) (USA)	*Monsanto Company* (USA)	TAL Nuclease Technologies (TALEN)	2012-04	"The Two Blades Foundation (2Blades) has completed a non-exclusive license agreement with the Monsanto Company for access to the TAL Code technology ***for genome engineering in plants***. … 2Blades will gain access to Monsanto's improvements to the technology for use in 2Blades' humanitarian efforts in support of subsistence farming."	41

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Two Blades Foundation (2Blades) (USA)	*Syngenta* (CH)	TAL Effector Technology (TALEN)	2012-01	"2Blades announces the signing of a non-exclusive license for the TAL Code technology to Syngenta ***for commercial uses in crop plants***. Syngenta will grant 2Blades access to its improvements to the technology for use in 2Blades' humanitarian efforts to support subsistence farming."	23
Martin-Luther-University Halle-Wittenberg (D) via *Two Blades Foundation (2Blades)* (USA)	*Life Technologies Corporation* (seit 2014 zu: *ThermoFisher Scientific*) (USA)	TAL Effector Technology (TALEN)	2011-10	"The exclusive license, made jointly with the technology inventors [of Martin-Luther-University], will enable Life Technologies to ***develop research tools for all applications,*** as well as for ***commercial non-plant uses***…." ↓	27
Martin-Luther-University Halle-Wittenberg (D)	*Two Blades Foundation (2Blades)* (USA)	TAL Effector Technology (TALEN)	after 2009	"...2Blades retains the rights ***for commercial applications in plants and green algae*** and intends to make licenses broadly available."	27
Dow AgroSciences (USA)	*Oregon State University* (USA)	EXZACT™ Precision Technology platform (ZFN)	2011-05	„Dow AgroSciences LLC (...) and Oregon State University have entered into a research agreement to apply EXZACT™ Precision Technology in trees, with the goal of ***accelerating and enhancing research into tree improvement.*** (…) Researchers at Oregon State University will make modifications to essential genes for flowering and reproduction."	29

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Bayer CropScience (D)	*KeyGene* (NL)	KeyBase methodology (ODM)	2011-06	„Bayer CropScience and KeyGene have entered into an exclusive trait development agreement. Both companies will combine their expertise in the fields of protoplast technology and targeted molecular mutagenesis ***to create novel traits for crop improvement***. The collaboration will initially focus on the use of KeyGene's new and proprietary KeyBase methodology ***to develop innovative traits for new oilseed rape varieties***. Bayer also has the option to expand the trait development alliance to include KeyBase-mediated development of proprietary Bayer and/or KeyGene traits in ***cotton and rice***."	38
Precision BioSciences Inc. (USA)	*BASF Plant Science* (D)	Directed Nuclease Editor™ (DNE) technology	2011-04	"BASF Plant Science and Precision BioSciences Inc., announced that they have entered into a collaborative agreement ***to create site-specific genome modifications in plants***. The agreement provides BASF Plant Science with non-exclusive access to aspects of Precision BioSciences' proprietary Directed Nuclease Editor™ (DNE) technology, which can be used ***to develop advanced agricultural products***."	35

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
University of Minnesota	*Cellectis* (FRA)	Inventions related to TAL effector-mediated DNA recognition and cleavage (TALEN)	2011-01	"Cellectis (…), the French genome engineering specialist, has announced today that it has signed an exclusive license agreement with the University of Minnesota that grants Cellectis the worldwide right to use inventions related to TAL effector-mediated DNA recognition and cleavage. This revolutionary approach for the targeted modification of genomes was developed by the University of Minnesota and Iowa State University. ***The exclusive license granted to Cellectis covers all uses of the technology in any field***."	25
Dow AgroScience LLC (USA)	*KWS SAAT AG* (D)	EXZACT™ Precision Technology (ZFN)	2010-09	"Dow AgroSciences LLC, a wholly owned subsidiary of The Dow Chemical Company (...), announced today that it has entered into a ***long-term research and product development agreement***, focused on the use of EXZACT™ Precision Technology, with KWS SAAT AG (KWS). Under the terms of the agreement, Dow AgroSciences will provide KWS with a ***commercial license*** option for traits and products developed with EXZACT Precision Technology ***in sugar beets***, as well as ***a research license for use in several row crops***."	39

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Dow AgroSciences LLC (USA)	*Wageningen UR (University and Research center)* (NL)	EXZACT™ Precision Technology (ZFN)	2010-09	"Dow AgroSciences LLC, a wholly owned subsidiary of The Dow Chemical Company (...), and the Plant Sciences Group of Wageningen UR (University and Research center) have entered into a research agreement to study how EXZACT™ Precision Technology ***can improve the starch quality of potato****, a food and industrial crop of global importance.* (...) This new research will extend (…) [the] functionalities [of the Technology] into potato, a crop that is difficult to breed using conventional methods."	45
Dow AgroSciences LLC (USA)	*Iowa State University* (USA)	EXZACT™ Precision Technology (ZFN)	2010-04	"Dow AgroSciences LLC (...) and Iowa State University have entered into a research agreement to study how EXZACT™ Precision Technology can help ***improve the development of renewable bioproducts in microalgae***. (…) As part of the agreement, researchers at Iowa State University will generate data demonstrating the utility of EXZACT™ in the microalgae Chlamydomonas, a model system for the green technologies that will produce the carbohydrates, lipids or hydrocarbons used in high-energy, renewable bioproducts. Dow AgroSciences is providing its technology as well as access to intellectual property, validated, high-quality zinc-finger reagents, and scientific expertise."	33

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Dow AgroSciences LLC (USA)	*Keygene N.V.* (NL)	EXZACT™ Precision Technology (ZFN)	2010-01	"… announced today that they have entered into a ***Trait Development Agreement.*** This agreement will allow Dow AgroSciences and KeyGene to combine their experience and technologies ***to develop traits for improved yield in tomatoes***. Under the terms of the agreement, Dow AgroSciences will provide KeyGene with access to EXZACT™ Precision Technology, its experience in targeted genome modification, and research support for use in a program focused on tomato yield enhancement. KeyGene will apply its expertise in molecular breeding, vegetable genetics and tomato protoplast technology to perform the research."	36
Cellectis (FRA)	*Monsanto Company* (USA)	Meganuclease technology	2009-09	"Monsanto Company (...) today announced a non-exclusive research and commercial license agreement with Cellectis S.A. (...) ***for broad use of its meganuclease technology in plants***. (…) Under the agreement, Monsanto will have access to Cellectis' intellectual property on meganucleases and its custom meganuclease production platform. Cellectis will receive an upfront payment of €3 million, and subject to the approval of the Extraordinary General Meeting of Cellectis' shareholders, Monsanto will make an equity investment of €1 million to allow Cellectis to scale the technology for agriculture. Cellectis will also be eligible to receive fees for the development of each meganuclease, success-based milestones and may receive royalties on certain traits commercialized by Monsanto."	16

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Sangamo BioSciences Inc. (USA)	*Dow AgroSciences* (USA)	Zinc finger technology (ZFP™)	2008-06	"… The license allows Dow AgroSciences to commercialize products incorporating or developed from plant cells using Sangamo's zinc finger DNA-binding protein (ZFP™) technology, in ***agricultural crops, industrial products and plant-derived biopharmaceuticals***. Sangamo and Dow AgroSciences have been collaborating in research to apply ZFP technology to plants under a three-year research and commercial license option agreement initiated in October 2005. (…) In addition to developing its own new products using the ZFP technology, Dow AgroSciences will sublicense the technology to third parties for development of particular products under the trademark name of EXZACT™ Precision Traits. The trademark name emphasizes the specificity and the precision of the technology. It can be used with precision to add new genetic material, delete genes altogether and even regulate or edit native genes."	24
Duke University (USA)	*Precision BioSciences Inc.* (USA)	Directed Nuclease Editor™ (DNE) technology	2006-04	"***Precision BioSciences Secures Exclusive Worldwide License to Duke University's Directed Nuclease Editor Patent and Related Materials.*** Precision BioSciences, Inc., a biotechnology company ***developing a novel platform technology to precisely target genome modifications***, announced (…) that it has signed an exclusive worldwide license for the Directed Nuclease Editor technology developed at the Duke University Medical Center. The license agreement includes the patent application and related materials that have already been developed at Duke."	20

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Sangamo BioSciences, Inc. (USA)	*Dow AgroSciences LLC* (USA)	Zinc finger technology (ZFP™)	2005-10	"Dow AgroSciences LLC, a wholly owned subsidiary of The Dow Chemical Company (...), and Sangamo BioSciences, Inc. (...) today announced the signing of a Research and Commercial License Agreement. The agreement provides Dow AgroSciences with ***access to Sangamo's proprietary zinc finger DNA-binding protein (ZFP) technology for use in plants and plant cell cultures to develop products in*** areas including, on an exclusive basis, ***plant agriculture and industrial products***, and, on a non-exclusive basis, ***animal health and biopharmaceutical products produced in plants.***"	12
Bayer Crop Science (D) Beteiligung an →	*Arcadia Bioscience* (USA)		2005-01	"Arcadia Biosciences, Inc., develops agricultural products for the improvement of agricultural crops. The company utilizes various technologies, both GM and non-GM, to develop its product portfolio, including precise genetic screening, advanced plant breeding techniques and genetic engineering. ...The main areas in which they are currently active include ***agricultural technologies*** (Nitrogen Use Efficiency, Salt Tolerance and Improved Process Efficiency) and ***health technologies*** (GLA Safflower Oil , Extended Shelf-Life Produce and Improved Nutrition Whole Foods). (…) Together with CMEA, Exeter Life Sciences and Saints Capital, [Bayer has] been involved with Arcadia since 2005."	21

Quellen

→ Zur Diskussion der komplizierten IP- und Lizenzsituation rund um CRISPR-Cas, siehe:

CRISPR, surrogate licensing, and scientific discovery

Jorge L. Contreras and Jacob S. Sherkow (February 16, 2017) *Science* **355** (6326), 698-700. [doi: 10.1126/science.aal4222]. Download: http://science.sciencemag.org/content/355/6326/698/tab-pdf

Zu den **breiten Ansprüchen rund um CRISPR-Cas9:**

CRISPR–Cas9 claim sets and the potential to stifle innovation

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1 https://www.genomeweb.com/applied-markets/ers-genomics-licenses-crisprcas9-evolva-industrial-applications

2 http://www.dowagro.com/en-us/newsroom/pressreleases/2016/10/monsanto-dow-agrosciences-global-licensing-agreement-exzact

3 http://www.cimmyt.org/press_release/dupont-pioneer-and-cimmyt-form-crispr-cas-publicprivate-partnership/

4 http://news.monsanto.com/press-release/corporate/monsanto-announces-global-licensing-agreement-broad-institute-key-genome-edi

5 http://news.monsanto.com/press-release/corporate/monsanto-and-targetgene-announce-agreement-gene-editing-technology-advance-g

6 http://www.businesswire.com/news/home/20160628005850/en/Monsanto-Nomad-Bioscience-Announce-Collaboration-Gene-Editing-Research

7 https://www.broadinstitute.org/news/licensing-crispr-agriculture-policy-considerations

8 https://www.pioneer.com/home/site/about/news-media/news-releases/template.CONTENT/guid.BAED75F2-4190-04E9-6549-0AA417910776

9 https://www.pioneer.com/home/site/about/news-media/news-releases/template.CONTENT/guid.00DA8BCD-A60A-E696-0179-E5BC63309087

10 http://www.calyxt.com/wp-content/uploads/2015/12/Calyxt-Press-Release-Research-Collaboration-16.12.15.pdf

11 http://www.agrivida.com/news/releases/20140310.html

12 http://investor.sangamo.com/releasedetail.cfm?ReleaseID=246992

13 http://www.sigmaaldrich.com/technical-documents/articles/biology/crispr-use-license-agreement.html

14 http://www.cellectis-plantsciences.com/wp-content/uploads/2015/04/PR_CPS_CRISPR_04152015.pdf

15 http://www.dowagro.com/en-us/newsroom/pressreleases/2015/3/dow-agrosciences-and-caas-partner-to-accelerate-rice-research-and-product-development-in-china

16 http://www.cellectis.com/en/content/monsanto-licenses-use-cellectis-innovative-genome-modification-technology-0

17 http://www.arcadiabio.com/news/press-release/dow-agrosciences-and-arcadia-biosciences-form-strategic-collaboration-develop-and

18 http://www.cellectis.com/sites/default/files/pr_cps_bayercropscience_20140130_en.pdf

19 https://www.dowagro.com/en-us/newsroom/pressreleases/2014/5/dow-agrosciences-sigmaaldrich-announce-manufacturing-and-supply-agreement#.WCMG-YUq5o4

20 http://www.evaluategroup.com/Universal/View.aspx?type=Story&id=272706

21 http://www.basf-vc.de/index.php?id=5&L=1

22 http://2blades.org/2012/12/10/2blades-pioneer-tal-technology/

23 http://2blades.org/2012/01/16/2blades-announces-the-signing-of-a-non-exclusive-license-for-the-tal-code-technology-to-syngenta-for-commercial-uses-in-crop-plants-syngenta-will-grant-2blades-access-to-its-improvements-to-the/

24 http://investor.sangamo.com/releasedetail.cfm?releaseid=317375

25 http://www.cellectis.com/en/content/cellectis-acquires-exclusive-license-tal-effector-patents-university-minnesota-0

26 http://www.cellectis.com/en/content/cellectis-extends-its-tal-technology-intellectual-property-portfolio-through-acquisition-two

27 http://2blades.org/2011/06/10/2blades-announces-the-licensing-of-the-plant-rights-for-the-tal-effector-code-to-life-technologies-for-research-tool-applications/

28 http://2blades.org/2014/12/18/cellectis-plant-sciences-and-two-blades-foundation-announce-the-execution-of-a-cross-license-agreement-on-tal-effector-nuclease-technologies/

29 http://newsroom.dowagro.com/press-release/dow-agrosciences-oregon-state-university-enter-research-agreement-tree-research-using-

30 http://www.cellectis.com/sites/default/files/cellectis_precision_01302014_en.pdf

31 http://www.researchtriangle.org/news-and-events/nova-synthetix-and-precision-biosciences-announce-collaboration

32 http://www.businesswire.com/news/home/20140320005890/en/Danziger-Innovations-Precision-BioSciences-Announce-Successful-Genome

33 http://newsroom.dowagro.com/press-release/dow-agrosciences-iowa-state-university-enter-research-agreement-using-exzacttm-precisi

34 http://newsroom.dowagro.com/press-release/dow-agrosciences-and-ics-caas-partner-accelerate-rice-research-and-product-development

35 http://www.agprofessional.com/news/basf_plant_science_licenses_precision_biosciences_site-specific_genome_modification_technology_120020659.html

36 http://newsroom.dowagro.com/press-release/2010/dow-agrosciences-keygene-enter-trait-development-agreement

37 http://www.agribusinessglobal.com/agrichemicals/biotech-firm-cibus-global-acquires-nucelis/

http://www.seedquest.com/news.php?type=news&id_article=44051&id_region=&id_category=176&id_crop=

38 http://seedworld.com/industry-news-2/

39 http://newsroom.dowagro.com/press-release/dow-agrosciences-kws-enter-agreement-research-product-development

40 http://sangamodomain.blogspot.de/2015/05/dow-agro-presentation-ezact-precision.html

41 http://2blades.org/2012/04/16/monsanto-has-completed-a-non-exclusive-license-with-2blades-for-commercial-uses-of-the-tal-code-technology-in-plants-improvements-to-the-technology-will-be-granted-back-for-2blades-humanitarian-pr/

42 http://2blades.org/2012/07/09/2blades-announces-the-completion-of-a-non-exclusive-license-with-kws-for-access-to-the-tal-code-technology-kws-will-grant-improvements-in-the-technology-back-to-2blades-for-subsistence-farming-appli/

43 http://2blades.org/2012/09/04/2blades-announces-the-expansion-of-rights-to-monsanto-under-our-non-exclusive-license-announced-in-april-2012-for-broader-access-to-the-tal-code-technology-2blades-will-continue-to-receive-a-gran/

44 http://2blades.org/2012/05/01/2blades-is-pleased-to-announce-completion-of-a-non-exclusive-license-agreement-with-bayer-cropscience-for-the-tal-code-genome-engineering-technology-2blades-will-receive-improvements-to-the-tal-code/

45 http://newsroom.dowagro.com/press-release/dow-agrosciences-wageningen-ur-enter-agreement-use-exzacttm-precision-technology

46 http://www.nasdaq.com/article/dow-chemical-inks-license-pact-with-agriculture-victoria-cm718982

47 https://www.basf.com/us/en/company/news-and-media/news-releases/2017/03/P-US-17-026.html

48 http://www.syngentacropprotection.com/news_releases/news.aspx?id=205353

49 http://2blades.org/2016/12/14/2blades-partners-irri-provide-access-gene-editing-technology-rice/

50 http://www.agvic.com.au/news/latest-news/new-project-with-dow-agrosciences

51 https://seekingalpha.com/pr/16936340-arcadia-biosciences-accelerate-agricultural-trait-development-crispr-cas9

52 https://monsanto.pr/monsanto-announces-global-genome-editing-licensing-agreement-with-broad-institute-for-newly-characterized-crispr-system/

53 http://www.ersgenomics.com/press-release-2017-06-27.php

54 https://www.agdaily.com/news/monsanto-toolgen-crispr-platform/

55 https://www.broadinstitute.org/news/dupont-pioneer-and-broad-institute-join-forces-enable-democratic-crispr-licensing-agriculture

56 http://cariboubio.com/in-the-news/press-releases/genus-and-caribou-biosciences-announce-exclusive-collaboration-leading

57 https://www.basf.com/en/company/news-and-media/news-releases/2018/10/p-IR-181024.html

58 http://www.simplot.com/news/simplot_secures_license_from_corteva_agriscience_mit_harvard

59 https://synbiobeta.com/yield10-bioscience-signs-research-license-agreement-covering-crispr-cas9/

60 http://precisionbiosciences.com/cargill-leverages-new-technology-precision-biosciences-develop-ultra-low-saturate-high-oleic-canola-oil/

61 http://2blades.org/2018/11/05/2blades-announces-completion-of-a-non-exclusive-license-with-epicrop-technologies-inc-for-access-to-the-tal-code-technology/

62 https://www.prnewswire.com/news-releases/ricetec-and-benson-hill-collaborate-to-explore-new-technologies-for-rice-improvement-300859637.html

63 https://www.businesswire.com/news/home/20190318005588/en/Pairwise-Licenses-CRISPR-Technologies-Massachusetts-General-Hospital

64 https://www.globenewswire.com/news-release/2019/04/02/1795476/0/en/Amfora-Licenses-Gene-Editing-Technology.html

65 https://www.cshl.edu/cold-spring-harbor-laboratory-announces-exclusive-license-with-plant-breeding-start-up-inari/

66 https://www.prnewswire.com/news-releases/inari-adds-powerful-plant-breeding-tools-through-exclusive-license-to-ucla-epigenetics-patents-300794398.html

67 https://www.nature.com/articles/d41587-019-00027-2

68 https://www.icrisat.org/icrisat-and-corteva-agriscience-agriculture-division-of-dowdupont-collaborate-for-sharing-advanced-breeding-technologies-to-improve-crops-that-feed-millions/

69 https://www.globenewswire.com/news-release/2019/12/09/1957624/0/en/JOINT-ANNUAL-GENERAL-MEETING-2019-APPOINTMENT-OF-S%C3%89BASTIEN-VIDAL-AS-CHAIRMAN-AND-CEO-OF-VILMORIN-CIE-SIGNATURE-OF-A-NEW-AGREEMENT-ON-GENOME-EDITING-TECHNIQUES.html

70 https://www.euractiv.com/section/agriculture-food/news/corteva-signs-first-major-gene-editing-deal-with-european-company/?utm_source=EURACTIV&utm_campaign=90452a12d0-RSS_EMAIL_EN_Daily_Update&utm_medium=email&utm_term=0_c59e2fd7a9-90452a12d0-114697831

71 https://www.vilmorincie.com/flipbook/20190218/39/#zoom=z p. 39

72 https://calyxt.com/calyxt-licenses-new-enabling-technology-from-university-of-minnesota-for-greater-efficiency-in-gene-edited-plants/

73 https://www.nature.com/articles/s41587-019-0337-2

74 https://biosafety-info.net/articles/key-regulatory-issues/contained-use/inventor-of-genome-editing-technique-caught-in-biosafety-violations/

75 https://www.tropicbioscience.com/basf-geigs

76 https://www.topagrar.com/acker/news/limagrain-erhaelt-kredit-von-europaeischer-investitionsbank-11987710.html

77 https://www.monsanto.pr/monsanto-announces-global-genome-editing-licensing-agreement-with-broad-institute-for-newly-characterized-crispr-system/