Im Auftrag des Bundesamtes für Umwelt (BAFU)

Tabellarische Übersichten

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

Forschungseinrichtungen/Universitäten

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

(Stand: Dezember 2016)

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Raps	Cibus-Raps	Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz	***Cibus*** (USA)	Zulassung USA (seit 2004), Kanada (seit 2014) **Anbau**: USA seit 2015 Kanada ab 2017	USA, Kanada (2011), Schweden (vor 2014), UK	1, 2, 41
Mais	Wachsmais	CRISPR	Wx1-Gen wurde ausgeschaltet: veränderte Stärkezusammensetzung	**DuPont Pioneer** (USA), *Caribou Biosciences (USA)*	Kommerzialisierung geplant ab 2021	USA, ab 2016	3,4,5
Mais		CRISPR	Trockenheitstoleranz	**DuPont Pioneer** (USA), *Caribou Biosciences (USA)*	Kommerzialisierung geplant ab 2021	USA, ab 2016	7, 8, 31
Mais		EXZACT™ precision tech-nology, ZFN	Herbizidresistenz, Veränderte Phytat-Biosynthese	**Dow AgroScience** (USA), *Sangamo (USA)*	Kurz vor der Kommer-zialisierung oder ev. bereits im **Anbau**, weitere Pflanzen (u. a. Raps) in Entwicklung	unklar	1, 19, 20, 21,40
Lein		Rapid Trait Development System (RTDS™), ODM, TALEN, CRISPR	Herbizidresistenz (Glyphosat)	***Cibus*** *(USA)*	Kommerzialisierung in den USA geplant ab 2019, in Kanada ab 2020	Ab 2017 geplant	6, 30, 45

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Reis		Rapid Trait Development System (RTDS™), ODM	Herbizidresistenz	***Cibus** (USA)*	Datum der Kommerzialisierung noch unklar – erst in den USA, dann in allen grossen Reis-Anbauländern	unklar	6
Soja		TALEN	Veränderte Fettsäurezusammen-setzung (High oleic)	***Calyxt Inc.*** (USA)	APHIS-Bescheid 2015, Kommerzialisierung ab 2018	Seit 2014 in den USA, Argentinien, 2016: 381 ha in 6 US-Bundesstaaten	15, 16, 17, 39, 43, 44
Soja		TALEN	Veränderte Fettsäurezusammen-setzung (High oleic)	***Calyxt Inc.*** (USA)	APHIS-Bescheid 2015, Kommerzialisierung ab 2018	Seit 2014 in den USA, Argentinien, 2016: 381 ha in 6 US-Bundesstaaten	42, 43, 44
Kartoffel	Innate™ 1 Generation & 2 Generation	Intragenese Cisgenese RNAi	Resistenz gegen Kraut- und Knollenfäule Weniger anfällig für grau-schwarze Flecken (an Druckstellen), Weniger Acrylamide, Lagerung bei kühleren Temperaturen	***J.R. Simplot*** (USA)	1. Generation: **Anbau** 2015: 160 Hektar, 2016: 800 Hektar (USA), in Kanada zugelassen 2. Generation: Zulassung USA (USDA), Kommerzialisierung ab 2017	1 Generation: mehrere Jahre auf Prince Edward Island (Kanada) 2 Generation: über 2 Jahre an 11 Standorten (USA)	1, 13, 29, 32, 33, 34

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Kartoffel	Ranger Russet	TALEN	Bessere Lagereigenschaften bei kühlen Temperaturen, weniger Acrylamid-Bildung beim Frittieren	***Calyxt Inc.*** (USA)	Kommerzialisierung ab 2019, APHIS-Bescheid 2014	USA, ab 2015	22, 23, 24, 36
Kartoffel	PPO_KO	TALEN	Bessere Lagereigenschaften bei kühlen Temperaturen, weniger Acrylamid-Bildung beim Frittieren, PPO-Enzym wurde ausgeschaltet	***Calyxt Inc.*** (USA)	APHIS-Bescheid 2016	Ja, wahrscheinlich USA	25,26, 35
Kartoffel		Rapid Trait Development System (RTDS™),ODM	Resistenz gegen Kraut- und Knollenfäule	***Cibus*** *(USA)*	Kommerzialisierung USA geplant um 2020, danach in allen grossen Kartoffel-Anbauländern	unklar	6
Kartoffel	Bintje	Cisgenese	Resistenz gegen Kraut- und Knollenfäule	Ghent University, Vlaams Instituut voor Biotechnologie (VIB), Institute for Agricultural and Fisheries Research (ILVO)	Kommerzialisierung ev. ab 2018	Freisetzungs-versuche ab 2017/2018 (Belgien)	37
Kartoffel	Maris Piper	Cisgenese ev. RNAi	Resistenz gegen Kraut- und Knollenfäule, Kartoffelzysten-nematoden, geringere Anfälligkeit gegen Druckstellen	TSL Potato Partnership Project (The Sainsbury Laboratory), University of Leeds, **J. R. Simplot**, **BioPotatoes UK Ltd**	ev. Kommerzialisierung ab 2025	Freisetzungsver suche 2016 – 2019 (UK)	38
Weizen		CRISPR	Hybridweizen	**DuPont Pioneer** (USA), *Caribou Biosciences* (USA)	Kommerzialisierung geplant ab 2021	USA, ab 2016	7, 8

Kultur	Pflanze (Sorte)	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c)]	Freisetzungs-versuche	Quelle
Apfel	Arctic Apple „Arctic Granny“ „Arctic Golden“ „Arctic Fuji"	Intragenese RNAi	Keine braune Verfärbung nach Anschneiden	*Okanagan Speciality Fruits* (seit 2015 zu **Intrexon**) (USA)	**Anbau**, Test-Kommer-zialisierung der Früchte Anfang 2017	USA, Kanada	1, 13, zum Arctic Fuji s. 28
Champig-non	Weisser Champignon	CRISPR	Keine braune Verfärbung nach Anschneiden, verbessertes Shelf-life	Prof. Yinong Yang, Pennsylvania State University (USA)	Forschung & Entwicklung, Kommerzialisierung noch unklar (s. Quelle 18)	unklar	9,10, 18

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

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

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

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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.:

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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:

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

(Stand: Dezember 2016)

→ 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	ev. Clearfield	Rapid Trait Development System (RTDS™),ODM	Herbizidresistenz	**BASF** (UK), *Cibus* (USA)	Forschung & Entwicklung	UK (2013)	17
Raps		TALEN	Veränderte Fettsäurezusammen-setzung	***Calyxt Inc.*** (ehemals Cellectis plant sciences) (USA)	Forschung & Entwicklung	unklar	29
Mais		RNAi	Trockenheitstoleranz	**DuPont Pioneer** (USA)	Forschung & Entwicklung	Chile, USA	1
Mais		CRISPR	Trockenheitstoleranz	**Du Pont Pioneer** (USA)	Forschung & Entwicklung	Ja, USA	8
Mais		Cisgenese	Kälte- und Trockenheitstoleranz	unbekannt (Mexiko)	Forschung (unklar ob Entwicklung)	unklar	2
Mais		Meganuklease-Technik	Veränderte Stärkezusammensetzung	***Agrivida Inc.*** (USA)	Forschung & Entwicklung	unklar	23,24
Kartoffel		Cisgenese	Kraut- und Knollenfäuleresistenz	*Universität Wageningen* (NL)	Forschung & Entwicklung Es ist derzeit unklar, ob Projekt weitergeführt wird (keine Finanzierung)	NL, CH, Irland, Belgien	1, 32

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Kartoffel		Cisgenese	Kraut- und Knollenfäuleresistenz	*Biotechnology and Biological Sciences Research Council (BBSRC)* (UK)	Forschung (unklar ob Entwicklung)	Freisetzungs-versuche (UK), 2010 - 2012	1
Kartoffel	Fortuna	Intragenese	Hoher Amylopectin-Gehalt	**BASF** (D)	Freisetzungsversuche EU, geplante Kommerzialisierung wurde zurückgezogen	Ja, verschiede-ne EU-Staaten 2006-2011	1, 14
Kartoffel		RNAi	Resistenz gegen Kartoffel-Y-Virus	*Shandong Universität* (China)	Forschung (unklar ob Entwicklung)	unklar	1
Kartoffel		RNAi	Reduzierter Acrylamidgehalt	*University of Wisconsin-Madison* (USA), *USDA/Agricultural Research Service*	Forschung & Entwicklung	unklar	1
Kartoffel		RNAi	Kraut- und Knollenfäule	*Leibniz-Institut für Pflanzen Biochemie* (D)	Forschung (unklar ob Entwicklung)	unklar	1
Getreide		Genome Editing	unbekannt	unbekannt (UK, Irland)	Forschung (unklar ob Entwicklung)	unklar	2
Weizen		RNAi	Resistenz gegen Blattläuse und weisse Fliege	*John Innes Center, Genome Analysis Center, Rothamsted Research, University of Greenwich* (UK)	Forschung (unklar ob Entwicklung)	Nein	1
Weizen		RNAi Transgenese	Reduzierter Glutengehalt	*Instituto de Agricultura Sostenible* (E)	Forschung & Entwicklung	Ja, 2013-2014	1, 36, 37
Weizen		RNAi	Erhöhter Amylose-Gehalt	*CSIRO* (Australien), *Biogemma UK Limited* (UK)	Forschung & Entwicklung	unklar	1

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Weizen	MLO_KO Weizen	TALEN	Mehltauresistenz	***Calyxt Inc.*** (USA)	Forschung & Entwicklung	unklar	21, 22
Weizen		TALEN	Reduzierter Glutengehalt	***Calyxt Inc.*** (USA)	Forschung & Entwicklung	unklar	30
Gerste		Cisgenese	Verbesserte Phytase-Aktivität	*Aarhus Universität* (DK)	Forschung (unklar ob Entwicklung)	Dänemark, 2012 - 2016	1
Gerste		CRISPR	Pilzresistenz (u. a. Mehltau)	*Institut für Phytopathologie, Universität Giessen, Cerealpath-Forschungsverbund* (D)	Forschung (unklar ob Entwicklung)	unklar	40, 41,42
Reis		TALEN	Resistenz gegen eine bakterielle Krankheit	*State University of Iowa, Prof. Bing Yang* (USA)	APHIS-Bescheid 2015, Forschung	Sommer 2014, Universitäts-gelände	25, 26
Versch. „Food crops“		ODM (ev. *Key Base*-Verfahren)	unbekannt	ev. ***Key Gene*** (NL)	Forschung (unklar ob Entwicklung)	unklar	2
Weidel-gras		Intragenese	Trockenheitstoleranz	***ViaLactia Bioscience***, (NZ) (Tochterfirma von Fonterra (NZ), Global dairy nutrition company)	Forschung & Entwicklung	unklar	1
Weidel-gras		Intragenese	Verbesserte Futtereigenschaften	unbekannt (AUS)	Forschung (unklar ob Entwicklung)	Australien	2
Alfalfa		Intragenese	Niedriger Ligningehalt	***J. R. Simplot*** (USA)	Forschung & Entwicklung	unklar	1
Lein-dotter		RNAi	Veränderte Fettsäurezusammen-setzung	*Rothamsted Research Center* (UK)	Forschung & Entwicklung	unklar	1

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Tomate		RNAi	Erhöhter Karotin- und Flavonoid-Gehalt	Forschungsverbund von Wissenschaftlern aus EU, USA	Forschung & Entwicklung	unklar	1
Tomate		TraitUp™ Technologie (Saatgut wird mit Plasmiden behandelt)	Robust gegen biotischen Stress	*Morflora* (Israel)	Forschung & Entwicklung	unklar	1, 18
Apfel, Birne		Pfropfen auf GV-Unterlage	Veränderte Wurzel-eigenschaften, Einfluss der GV-Unterlage auf Wachstum, Blüte etc.	*Swedish University of Agricultural Sciences* (Schweden)	Forschung (unklar ob Entwicklung)	Schweden, 2015 - 2019	1, 15, 34
Apfel		Cisgenese	Erhöhter Anthocyan-Gehalt	*Stichting Dienst Land-bouwkundig Onderzoek (DLO), Stichting Dienst Landbouwkundig Onderzoek (DLO)* in particular *Praktijk-onderzoek Plant, Om-geving / Plant Research International (PPO/PRI)* (NL)	Forschung (unklar ob Entwicklung)	NL, 2016 - 2026	1, 11, 33
Apfel		Cisgenese	Feuerbrandresistenz	*ETH Zürich* (CH), *Agroscope* (CH)	Forschung [d)]	Mit Auflagen in CH bewilligt 2016 - 2019	1, 12
Apfel		Cisgenese	Schorfresistenz	*ETH Zürich* (CH), *Universität Wageningen* (NL)	Forschung (unklar ob Entwicklung), teilweise Regulierung, USDA 2012 (siehe Quelle 47)	NL, Umfang unbekannt	1, 47

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Apfel, Birne		unbekannt	Feuerbrandresistenz	*Okanagan Speciality Fruits* (seit 2015 zu **Intrexon**) (USA)	Forschung & Entwicklung	unklar	27
Apfel		unbekannt	Schorfresistenz	*Okanagan Speciality Fruits* (seit 2015 zu **Intrexon**) (USA)	Forschung & Entwicklung	unklar	27
Pflaume, Aprikose		Pfropfen auf GV-Unterlage	Trockenheitstoleranz u. a.	*Centro de Edafología y Biología del Segura* (E)	Forschung (unklar ob Entwicklung)	Spanien, 2015 - 2018	1, 16, 35
Pflaume		RNAi Transgenese	Virusresistenz	Öffentlich finanziertes EU-Forschungsprojekt, Kooperation mit USA	Kommerzieller Anbau in den USA erlaubt, findet derzeit aber nicht statt	1996-2005 Tschechien, Polen, Rumänien, Spanien, 2 kleine Flächen in den USA	1, 13
Pfirsich		unbekannt	Resistenz gegen *Plum pox virus*	*Okanagan Speciality Fruits* (seit 2015 zu **Intrexon**) (USA)	Forschung & Entwicklung	unklar	27
Walnuss		Pfropfen auf GV-Unterlage	Resistenz gegen *Crown Gall disease*	*Department of Pomology*, *University of California* (USA)	Forschung und Entwicklung, gemäss OECD-Workshop (2): „Close to commercialization"	unklar	43, 2
Erdbeere		Cisgenese	Ertragssteigerung, verbessertes Shelf life, erhöhter Zuckergehalt, Krankheitsresistenz	***J. R. Simplot*** (USA)	Forschung & Entwicklung	Ja, ab 2015	38, 39
Weinrebe		Cisgenese	Pilzresistenz	*University of Florida, Fort Valley State University* (USA)	Forschung (unklar ob Entwicklung)	unklar	1

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Weinrebe		Intragenese	Erhöhter Anthocyan-Gehalt	*University of Florida* (USA)	Keine Regulierung, USDA-Bescheid 2012	unklar	1, 44, 46
Weinrebe		Pfropfen auf GV-Unterlage	Resistenz gegen die bakterielle *Pierce disease*	*Department of Viticulture and Enology, University of California* (USA)	Forschung & Entwicklung, gemäss OECD-Workshop (2): „Product development for commercialization"	unklar	2,45
Weinrebe		Pfropfen auf GV-Unterlage	Resistenz gegen Reisigkrankheit	*French National Institute for Agricultural Research (INRA)*(FRA)	Forschung (unklar ob Entwicklung)	ab 2010, Dauer unbekannt	44
Zitrone/ Orange		Pfropfen auf GV-Unterlage	unbekannt	unbekannt (Argentinien)	Forschung (unklar ob Entwicklung)	unklar	2
Banane		RNAi	u. a. Pilzresistenz	Versch. Forschungsinstitute USA, Uganda etc.	Forschung (unklar ob Entwicklung)	Nein	1
Papaya		Cisgenese	Pilzresistenz	unbekannt (Mexiko)	Forschung (unklar ob Entwicklung)	unklar	2
Ananas	Rosé	RNAi und ev. weiteres Verfahren	Erhöhter Lycopin-Gehalt	***Del Monte*** (USA) Kommerzialisierung über Del Monte unwahrscheinlich (s. Quelle 28)	**Anbau** in Costa Rica, in den USA seit 2013 zum Verzehr zugelassen (USDA)	wahrscheinlich	1, 28
Kassava		RNAi	Krankheitsresistenz	Verschiedene Forschungsinstitute USA, Uganda etc.	Forschung (unklar ob Entwicklung)	Kenia, Uganda	1
Bäume		RNAi	Veränderte Lignin-Zusammensetzung	unbekannt (Belgien)	Forschung (unklar ob Entwicklung)	Belgien	2

Kultur	Pflanze	Verfahren [a)]	Eigenschaften	Unternehmen [b)]	Entwicklungs-status [c), d)]	Freisetzungs-versuche	Quelle
Pappel		Cisgenese	Verschiedene Wachstumstypen	*Oregon State University, (USA), Michigan Technological* University, (USA), *USDA/ARS*	Forschung [d)]	unklar	1
Pappel		CRISPR Transgenese	Grundlagenforschung	*Umeå University, Department of Plant Physiology* (Schweden)	Forschung [d)]	2016 – 2021, Schweden	31
	Acker-Schmalwand (Arabidopsis thaliana)	CRISPR	Protein PsbS („Sicherheitsventil“ in der Photosynthese) wurde ausgeschaltet	*Umeå Plant Science Centre and Umeå University* (Schweden)	Forschung [d)]	Ab Sommer 2016, Schweden	19, 20

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

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.

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Lizenzvereinbarungen und Kooperationen

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

im Bereich der neuen gentechnischen Verfahren (2005 – 2016)

(Stand: Dezember 2016)

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
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

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
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 and Wheat Improvement Center (CIMMYT)* (Mexico)	CRISPR	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
Broad Institute (USA)	*Monsanto Company* (USA)	CRISPR	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

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
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
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

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Caribou BioSciences Inc. (USA) ⇄	*DuPont Pioneer* (USA) Kreuzlizenzierung	CRISPR	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
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

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
Vilnius University, Institute of Biotechnology (Lithuania)	*DuPont Pioneer* (USA)	CRISPR	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
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	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

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
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
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)	*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

Lizenzgeber	***Lizenznehmer***	***Verfahren***	***Jahr-Monat***	***Verwendungszweck***	***Quelle***
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

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