

United States Court of Appeals for the Federal Circuit

00-1001, -1051

MYCOGEN PLANT SCIENCE, INC. and AGRIGENETICS, INC.,

Plaintiffs-Appellants,

v.

MONSANTO COMPANY and DEKALB GENETICS CORPORATION,

Defendants-Cross Appellants,

and

DELTA AND PINE LAND COMPANY,

Defendant-Cross Appellant.

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Appealed from: United States District Court for the District of Delaware

Judge Roderick R. McKelvie

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DECIDED: March 12, 2001

Before CLEVENGER, BRYSON, and LINN, Circuit Judges.

CLEVENGER, Circuit Judge.

Mycogen Plant Science, Inc. and Agrigenetics, Inc. (collectively, "Mycogen") appeal the decision of the United States District Court for the District of Delaware upholding a jury verdict of patent invalidity pursuant to 35 U.S.C. § 102(g) in favor of Monsanto Company, DeKalb Genetics Corporation, and Delta and Pine Land Company (collectively, "Monsanto"). The patents at issue in this trial are U.S. Patent No. 5,567,600 ("the '600 patent") and U.S. Patent No. 5,567,862 ("the '862 patent"). Mycogen also appeals the denial of its motion for a new trial, portions of the district court's claim construction, portions of the jury instructions relating to simultaneous conception and reduction to practice, and the district court's grant of judgment as a matter of law ("JMOL") of patent invalidity due to lack of enablement pursuant to 35 U.S.C. § 112.

On cross-appeal, Monsanto challenges the district court's grant of JMOL holding that Mycogen did not commit inequitable conduct. Monsanto also cross-appeals the district court's ruling that Monsanto is liable for inducement of infringement by Monsanto's licensee Pioneer Hi-Bred International ("Pioneer").

We affirm the verdict of noninfringement based upon patent invalidity due to prior invention pursuant to 35 U.S.C. § 102(g). This ruling makes it unnecessary to address the finding of lack of enablement pursuant to 35 U.S.C. § 112. We also affirm the district court's denial of Mycogen's motion for a new trial, the district court's claim construction, and the jury instructions relating to simultaneous conception and reduction to practice.

Our ruling affirming patent invalidity moots the cross-appeals of inequitable conduct and liability for inducement of infringement by Pioneer.

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Procedural History

Mycogen sued Monsanto for infringement of two of Mycogen's patents, the '600 patent and the '862 patent, both of which are entitled "Synthetic Insecticidal Crystal Protein Gene," and both of which issued on October 22, 1996. Both patents involve genetically engineering plant genes for the purpose of protecting plants from insect pests. The claims of the patents-in-suit are similar, and their specifications are virtually identical. The '600 and '862 patents are children patents of Mycogen's U.S. Patent No. 5,380,831 ("the '831 parent patent"), also entitled "Synthetic Insecticidal Crystal Protein Gene," which issued on January 10, 1995. The '831 parent patent was the subject of additional litigation between Mycogen and Monsanto in the District Court for the Southern District of California. Mycogen Plant Science, Inc. v. Monsanto Co., No. 95-CV-653 (S.D. Cal. Nov. 10, 1999).

In the present case, the district court held an initial claim construction hearing regarding certain terms in the claim limitations of the '600 and '862 patents. Mycogen Plant Science, Inc. v. Monsanto Co., No. 96-505 (D. Del. Dec. 29, 1997) [hereinafter Mycogen claim construction]. The case was then tried before a jury in a ten-day trial from January 20 to February 3, 1998.

All 24 claims of the '600 patent and all 24 claims of the '862 patent were at issue in the trial. A variety of different Monsanto products were accused of infringement, including Bt genes adapted for expression in potato, corn, and cotton plants. At the close of the trial, the jury was given a special verdict form with 17 different questions covering the issues of infringement, validity and damages. On February 3, 1998, the jury returned a verdict finding that the defendants' products did not literally infringe the contested claims of either the '600 patent or the '862 patent. The jury also found that all of the contested claims of both the '600 and '862 patents were anticipated and therefore invalid because Monsanto invented the subject matter before the priority date of Mycogen's patents.

The jury did not enter a decision on the verdict questions regarding whether Monsanto actively induced others to make, use, sell, or offer to sell infringing products, or whether Monsanto actively induced farmers to infringe by using infringing products. In addition, the jury did not reach a decision but noted "N/A" to the following questions: (1) whether any of the contested claims of the '600 and '862 patents are invalid because the specification of the patents would not have enabled a person of ordinary skill in the art as of September 9, 1988, to make use of the claimed invention without undue experimentation; (2) whether the '600 and '862 patents are invalid because the inventors failed to adequately disclose in the patent specification what they believed, as of September 9, 1988, to be the best mode for practicing their invention; and (3) whether the '600 and '862 patents are invalid because they do not clearly and distinctly claim the subject matter of the invention. Exactly what "N/A" stands for on the jury verdict and interrogatory form is unclear and was the subject of post-trial dispute by the parties. On February 5, 1998, the district court entered judgment in favor of defendants. Mycogen Plant Science, Inc. v. Monsanto Co., No. 96-505 (D. Del. Feb. 5, 1998).

Both parties then made a variety of post-trial motions. In particular, Mycogen made a motion for a new trial on a theory of inconsistent jury verdicts. Mycogen argued that the jury's finding of noninfringement was inconsistent with the jury's finding of anticipation due to prior invention by Monsanto, because the gene products that formed the basis of the anticipatory prior invention research were also the foundation for the various allegedly infringing Monsanto products.

The district court issued a post-trial opinion on August 18, 1999, and issued a revised opinion on September 8, 1999, ruling on the post-trial motions. Mycogen Plant Science, Inc. v. Monsanto Co., 61 F. Supp. 2d 199 (D. Del. 1999). The district court first granted Mycogen's motion for JMOL that Monsanto's processes and resulting products infringed and that Monsanto also induced infringement of the '600 and '862 patents. Reasoning that this JMOL resolved the issue of inconsistent verdicts, the district court then denied Mycogen's motion for a new trial. The district court also denied Mycogen's motion for JMOL requesting the court to set aside the jury's finding of anticipation due to prior invention by Monsanto.

The district court granted Monsanto's motion for JMOL holding that the claims of the '600 and '862 patents were invalid for lack of enablement pursuant to 35 U.S.C. § 112. The district court denied Monsanto's motion for attorneys' fees based upon alleged inequitable conduct by Mycogen.

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Scientific Background

The district court's opinion provides an excellent, detailed explanation of the relevant science pertaining to the patents at issue. An understanding of the relevant technology is important for a full understanding of the legal questions addressed herein. Therefore, we substantially reproduce the scientific background information portion of the district court's opinion:

Two scientific topics are central to this case: (1) *Bacillus thuringiensis* ("Bt"), a naturally occurring bacterium; and (2) genetic engineering.

A. Background information on *Bacillus thuringiensis*

Bacillus thuringiensis is a naturally occurring bacterium found in soil. Bt possesses an unusual property - it produces a protein that kills certain crop-destroying insects. This protein is known as a "pesticidal protein toxin," "pesticidal protein," or "toxic crystal protein." When eaten by certain insects, the protein dissolves the insects' stomach linings, causing the insects to die. While the Bt protein is a natural pesticide, it is not harmful to humans, animals, or beneficial insects like bees and ladybugs.

The Bt protein is particularly deadly for insects like the European corn borer. This worm-like insect feeds on corn plants, eating its way into stalks and ears. The European corn borer can kill a plant outright or dramatically reduce the size and number of kernels that grow on an ear. This pest costs American farmers as much as an estimated \$1 billion a year in lost crops.

For years, farmers have been spraying their crops with pesticides like the Bt protein as well as other chemicals. Spraying, however, is not always effective because some insects, including the European corn borer, tunnel into plants soon after the insects hatch or stay on the underside of leaves, where the spray does not reach them. In addition to being ineffective, spraying adds to farmers' costs and the spraying of some pesticides raises environmental and health concerns.

Scientists have long considered the idea of introducing genes from different organisms into crops and livestock. Developments in genetic engineering focused the scientific community's attention on whether plants could somehow be genetically modified to resist attack by insect pests. Advances in agricultural biotechnologies made it possible to create plants which produce Bt pesticidal proteins. Thus, these genetically modified plants have their own built-in, or endogenous, protection from insects. Issues related to these biotechnological advances are at the heart of this case.

Initially, scientists experimented with inserting into plant cells the native Bt gene that produces the Bt pesticidal protein. The native Bt gene refers to the naturally occurring gene as found in the bacterium. While scientists succeeded in inserting native Bt genes into plant cells, they found that these new genetically modified plants were not producing enough Bt pesticidal protein to kill insects. In scientific terms, the level of expression of the native Bt genes inserted into the plants was too low.

To solve the problem of low Bt pesticidal protein production, scientists devised ways to increase the level of Bt expression in plants. They eventually succeeded by modifying the native Bt gene in various ways. Scientific success led to commercial success. The U.S. Environmental Protection Agency gave its first approval to a plant genetically engineered to biologically control insects on May 5, 1995, when it approved a genetically modified potato. The use of genetically modified crops dramatically increased from 1996 to 1999.

The patents-in-suit involve a method aimed at solving the problem of low Bt expression in genetically modified plants. To help the reader understand this method and the issues underlying this case, the following background information on genetic engineering is provided.

B. Background information on genetic engineering

Organisms, like plants and animals, are made up of cells. Genes are comprised of DNA (deoxyribonucleic acid), which encodes the necessary information for cells to reproduce and to produce specific proteins.

DNA consists of two long chains or strands that wrap around each other in a shape known as a double-stranded spiral helix. Visually, a molecule of DNA resembles a twisted ladder. The sides of the ladder are connected by rungs made up of pairs of molecules called nucleotides. Four different nucleotides, each containing one of the bases adenine ("A"), guanine ("G"), cytosine ("C") and thymine ("T"), form the particular DNA make-up of genes. A particular DNA molecule can be graphically represented by listing the nucleotide sequences making up that DNA molecule.

Because of the nucleotides' chemical make-up, A will only pair with T, and C will only pair with G. This strict complementary pairing means that the order of the nucleotides on one side of a DNA rung determines the order on the other side of the rung. Therefore, each rung of the ladder is composed of one pair consisting of A and T, or C and G. Each rung is called a nucleotide pair, and the order in which these nucleotide pairs appear on the DNA ladder constitutes the genetic code for the cell.

DNA directs cells to make proteins through a two-step process of transcription and translation. In the first step, transcription, information is transferred from DNA to an RNA, or ribonucleic acid, molecule. RNA that codes for a protein is called messenger RNA ("mRNA").

RNA is a long single strand of linked nucleotides similar to DNA. However, one of the differences between DNA and RNA is that RNA contains the base uracil ("U") in place of thymine. In transcription, specific nucleotide sequences on the DNA determine where the RNA copy begins and ends.

In the second step, translation, the nucleotide sequence of the mRNA is translated into the amino acid sequence of the corresponding protein. For this translation work, a complex structure known as a ribosome reads the mRNA nucleotide sequence and generates amino acids. These amino acids are then assembled into proteins. In this way, ribosomes carry out protein synthesis.

Ribosomes read a nucleotide sequence in sets of three nucleotides, known as codons. Each

codon directs the ribosome to select a certain amino acid. For example, GCT is a codon directing the ribosome to select the amino acid alanine. Just as nucleotides are the basic units of DNA, amino acids are the basic units of proteins. Thus, a given series of codons specifies a sequence of amino acids comprising a particular protein. A protein can contain few or many amino acids. For example, some Bt pesticidal proteins contain more than 600 amino acids.

While there are 61 possible codons, there are only 20 amino acids. Some amino acids can be specified by more than one codon. In other words, one codon can be substituted for another in the gene without changing the amino acid and resulting protein. For instance, the amino acid alanine is specified by four different codons: GCT, GCG, GCC and GCA. Two very different series of codons could produce the exact same series of amino acids. In fact, most amino acids are specified or coded by more than one codon.

Scientists employ special tables known as codon usage tables to determine the frequency with which certain codons appear in particular plants and other organisms. For example, Table 1 of the '600 and '862 patents contains a listing of all 20 amino acids along with the various codons which specify these amino acids. Table 1 then compares the frequency with which the codon appears in three different organisms: dicot plants, the Bt organism and monocot plants.

The terms "dicot" and "monocot" refer to two plant categories. A plant is classified as monocot or dicot depending on how many leaves it produces when it sprouts from the seed. If the plant has only one leaf when it first emerges from the soil, it is a monocot; if the plant has two leaves, it is a dicot. For example, tomato, tobacco and cotton are dicots; corn, barley, rice and wheat are monocots.

Knowing that different codons can specify the same amino acid, scientists attempted to solve the problem of low Bt expression in plants by changing the codons in the native Bt gene, without changing the resulting amino acids. Scientists recognized that organisms prefer certain codons over others for specifying particular amino acids. For example, while the amino acid alanine is specified by four different codons, GCG, GCA, GCT and GCC, the codons appear disproportionately. To illustrate this point, GCA appears 50 percent of the time that alanine is specified in Bt genes, while GCG only appears 12 percent of the time that alanine is specified in Bt genes.

Scientists sought to create a Bt gene that would have a codon frequency more like plants, but produce high levels of pesticidal Bt protein. Thus, by changing GCA codons in the Bt gene to either GCC or GCT, the new Bt gene becomes more plant-like because dicot plants prefer GCC or GCT over GCA. Modifications such as these result in higher expression of the pesticidal Bt protein in the plants containing this synthetic Bt gene, compared to those plants containing the native Bt gene.

Scientists also discovered that the nucleotide sequence AT appears in Bt genes more frequently than it appears in plant genes. They thought that this factor, along with the existence of other identifiable sequences, might be the cause of low Bt expression in plants. Who made these discoveries, when they were made, and how these discoveries were used to design an insecticidal Bt gene are all key elements of this case. Mycogen, 61 F. Supp. 2d at 206-210.

Mycogen appeals the district court's denial of a new trial based upon the theory of inconsistent jury verdicts. At trial, the jury returned a set of findings indicating that Monsanto's products did not literally infringe the claims of the '600 and '862 patents-in-suit. Simultaneously, the jury also returned a set of findings indicating that research performed by Monsanto anticipated the patents-in-suit under the doctrine of prior invention. Because this research performed by Monsanto led to the creation of the products considered to be noninfringing by the jury, Mycogen argues that the jury verdict is inconsistent and cannot stand. The tests for infringement and anticipation are very similar, and "[t]hat which would *literally* infringe if later in time anticipates if earlier than the date of invention." Lewmar Marine, Inc. v. Bariant, Inc., 827 F.2d 744, 747, 3 USPQ2d 1766, 1768 (Fed. Cir. 1987). Thus, a plausible argument can be made that the findings within the jury verdict are inconsistent.

However, the district court granted Mycogen's motion for JMOL that Monsanto's products did literally infringe the claims of the '600 and '862 patents. If proper, this JMOL removes any potential inconsistency within the jury's verdict.

JMOL is appropriate when "a party has been fully heard on an issue and there is no legally sufficient evidentiary basis for a reasonable jury to find for that party on that issue." Fed. R. Civ. P. 50(a)(1). We review a grant of JMOL without deference to the district court. See, e.g., Odetics, Inc. v. Storage Tech. Corp., 185 F.3d 1259, 1266, 51 USPQ2d 1225, 1228 (Fed. Cir. 1999); Texas Instruments Inc. v. Cypress Semiconductor Corp., 90 F.3d 1558, 1563, 39 USPQ2d 1492, 1496 (Fed. Cir. 1996). Entry of JMOL is inappropriate unless the jury's verdict is unsupported by substantial evidence or premised on incorrect legal standards. See, e.g., Odetics, 185 F.3d at 1266, 51 USPQ2d at 1229; Applied Med. Res. Corp. v. United States Surgical Corp., 147 F.3d 1374, 1376, 47 USPQ2d 1289, 1290-91 (Fed. Cir. 1998), cert. denied, 525 U.S. 1104 (1999).

The district court analyzed the infringement decision and stated "[f]or every one of [Monsanto's] accused genes and gene products, Mycogen presented evidence, detailed below, showing that a particular codon usage table was used to design each accused gene in a way that infringes the '600 and '862 patents. Defendants did not challenge this evidence." Mycogen, 61 F. Supp. 2d at 245. The district court then analyzed the evidence presented regarding each of Monsanto's accused products individually. With regard to Monsanto's New Leaf® potato gene and gene products, Cry3B2 corn gene and gene products, Cry2B corn gene and gene products, Cry1A(c)/Cry1F gene and gene products, and IRM1 corn gene and gene products, the district court found that "[b]ased upon this evidence and the lack of evidence to the contrary, the court finds the only reasonable conclusion is that Monsanto's [products] are infringing. Therefore, Mycogen is entitled to JMOL of infringement on Monsanto's [products]." Mycogen, 61 F. Supp. 2d at 245-48. The district court similarly found that regarding Delta and Pine Land's BollGard® cotton gene and gene products, and third-party products containing Monsanto's YieldGard® genes, "the only reasonable conclusion" was infringement. Id. at 248-51. The district court also stated that the evidence established that Monsanto's Stoneville cotton gene and gene products, as well as DEKALBt™ corn gene and gene products, "literally infringe". Id. at 250-51.

The district court applied the proper standard in determining that a grant of JMOL was appropriate regarding infringement, and performed a careful analysis of the evidence regarding each accused product. On appeal, Monsanto does not challenge the judgment that its products literally infringe. Therefore, we may proceed to the broader question of whether it is ever correct for a judge to use JMOL to excise a portion of an allegedly inconsistent verdict.

The issue of inconsistent verdicts is a procedural issue that is not unique to patent law. The Federal Circuit applies the law of the regional circuit, in this case, the Third Circuit, to the issue of inconsistent verdicts. See Allen Organ Co. v. Kimball Int'l, Inc., 839 F.2d 1556, 1563, 5 USPQ2d 1769, 1774 (Fed. Cir. 1988). In the Third Circuit, an inconsistent verdict is grounds for ordering a new trial. Malley-Duff & Assocs., Inc. v. Crown Life Ins. Co., 734 F.2d 133, 145 (3d Cir. 1984).

Certainly, it would be inappropriate to grant JMOL solely to rationalize inconsistent verdicts. The Third Circuit has clearly ruled as such in Mosley v. Wilson, 102 F.3d 85 (3d Cir. 1996), stating:

Here, the district court did not conclude that there was insufficient evidence to support the jury's finding of malicious prosecution. Instead, the court concluded only that the jury's verdict for [plaintiff] on the malicious prosecution claim was inconsistent with its verdict for [defendant] on the civil rights claim.

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Mosley, 102 F.3d at 89.

[I]t would be "neither fair nor appropriate simply to excise the jury's finding and to enter judgment for defendant" based on the jury's verdict on a different claim that rendered the verdicts inconsistent. Without the court finding that the evidence was insufficient, the decision would be arbitrary and would trench on the Seventh Amendment.

Id. at 90 (quoting Repola v. Morbark Indus., Inc., 934 F.2d 483, 495 (3d Cir. 1991) (internal alterations omitted)).

However, we conclude that in the present case, the district court applied the correct legal standard for determining whether JMOL was appropriate. It is true that the grant of JMOL that Monsanto's products infringe resolves the problem of inconsistent verdicts. However, JMOL was not granted solely to resolve the problem of inconsistent verdicts, but instead to properly correct an irrational portion of the jury's verdict.

It is well settled that the courts have a duty to attempt to resolve potentially inconsistent verdicts. The Supreme Court, in Gallick v. Baltimore & Ohio Railroad Co., 372 U.S. 108, 119 (1963), stated:

[I]t is the duty of the courts to attempt to harmonize the answers, if it is possible under a fair reading of them: "Where there is a view of the case that makes the jury's answers to special interrogatories consistent, they must be resolved that way." Atlantic & Gulf Stevedores, Inc., v. Ellerman Lines, Ltd., 369 U.S. 355, 364 [(1962)]. We therefore must attempt to reconcile the jury's findings, by exegesis if necessary, . . . before we are free to disregard the jury's special verdict and remand the case for a new trial.

Thus, if a jury returns a verdict that contains portions that may be inconsistent, the law does

not state that the verdict must be thrown out immediately and a new trial ordered. Instead, the district court is first instructed to carefully review the different portions of the jury's verdict for a means to reconcile them. Here, the district court reviewed the jury's findings of noninfringement and found that they were without a legally sufficient evidentiary basis. These are proper grounds for JMOL of infringement. The fact that this JMOL ruling also resolves the inconsistency within the verdicts does not render the JMOL ruling incorrect.

Of course, this single JMOL ruling does not remove the district court's duty to review other portions of the verdict for which a party has moved for JMOL. Once all such motions have been reviewed and ruled upon, the court should revisit the issue of inconsistent verdicts. Where, as here, a proper grant of JMOL has rendered the verdicts consistent, the inquiry is at an end. The verdicts are consistent and the issue does not provide grounds for a new trial.

To the extent that Mycogen suggests that the jury's verdicts on infringement and invalidity were so hopelessly inconsistent as to not justify reliance on any portion of the verdict, we note that the jury was instructed, without objection, that infringement constitutes the making, using, selling, or offering to sell a product "legally protected by at least one of the claims of the patent." In light of that instruction, the jury might well have concluded that upon finding the patents invalid, it had to conclude that the asserted claims were not infringed, since the logical consequence of a determination of invalidity would be that the inventions recited in the claims were not "legally protected." While that conclusion would be legally erroneous, as the district court recognized, it does not reflect necessary inconsistency in the jury's verdict.

IV

Mycogen contests a portion of the district court's claim construction. Specifically, Mycogen contends that the district court's definition of the "greater number of codons preferred" language in independent claims 1, 2, 13 and 14 of the '600 patent is erroneous. However, the claim construction issue here relates to both the '600 and the '862 patent, as well as the original '831 parent patent, as all three patents contain claims that use the language disputed herein. Claim 1 of the '600 patent is representative, and it reads as follows:

1. A method of designing a synthetic *Bacillus thuringiensis* gene to be more highly expressed in plants, comprising the steps of:

(a) analyzing the coding sequence of a gene derived from a *Bacillus thuringiensis* which encodes a pesticidal protein toxin;

(b) modifying a portion of said coding sequence to yield a modified sequence which contains a greater number of codons preferred by the intended plant host than did said coding sequence prior to modification, said modification comprising reducing the number codons having CG in codon positions II and III in a region between plant polyadenylation signals in said coding sequence;

(c) inserting said modified sequence into the genome of a plant cell; and

(d) maintaining said plant cell under conditions suitable to allow replication of said plant cell to produce additional plant cells having said modified sequence in the genome of said additional plant cells, wherein said synthetic *Bacillus thuringiensis* gene is expressed to produce a pesticidal protein toxin.

'600 patent, col. 31, lines 37-57 (emphasis added).

In Mycogen, the district court held that:

[T]he phrase "greater number of codons preferred," is satisfied where the newly-created synthetic gene has a higher number of those codons whose frequency in the native Bt gene was lower than their frequency in the intended plant host, and where the synthetic gene has an overall distribution of codon usage that is closer to that of the intended plant host.

61 F. Supp. 2d at 215. Thus, the district court's claim construction defines a "preferred codon" to be any codon that brings the modified Bt gene's codon frequency closer to that of the intended plant host. Mycogen argued during claim construction that the term refers to those codons that appear most frequently for each individual amino acid. Since there are 20 amino acids, exactly 20 of the 61 existing codons are "preferred" in any specific organism. See Mycogen claim construction at 18-19.

The difference between these two definitions is best illustrated by an example. GCG, GCA, GCT and GCC codons all code for the amino acid alanine. Table 1 of the '600 patent contains the following information regarding the frequency of codon usage for dicot plant proteins and Bt proteins:

	Dicot Genes	Bt Genes
GCG	0.06	0.12
GCA	0.25	0.50
GCT	0.42	0.32
GCC	0.27	0.06

'600 patent, col. 16, lines 47-50. According to the above table, the codon GCT appears most frequently in the dicot gene when coding for alanine. Thus, under Mycogen's definition of "preferred codon," only the GCT codon is a "preferred codon" for dicot plant proteins. However, under the district court's definition, both an addition of GCT and an addition of GCC would bring the Bt gene closer to the codon frequency of the dicot gene, and thus either one of these codons would be considered a "preferred codon."

When defining a claim term, we look first to the words of the claim itself. Vitronics Corp. v. Conceptor, Inc., 90 F.3d 1576, 1582, 39 USPQ2d 1573, 1576 (Fed. Cir. 1996). Mycogen's proffered definition of "preferred codon" specifies that only the most preferred codon is considered "preferred." This definition appears to read an additional limitation into the term "preferred codon" that is not evident from the plain meaning of the phrase. However, a patentee is free to be his own lexicographer, so long as the special definition of a term is made explicit in the patent specification or file history. Id. Thus we must examine whether these additional sources of intrinsic evidence shed further light on the definition.

The term "preferred codon" is never explicitly defined in the '600 patent specification. However, the written description uses the terms "codons preferred" and "preferred codons" multiple times. For example, the '600 written description states:

[I]n designing a synthetic gene encoding the Btt crystal protein, individual amino acid codons found in the original Btt gene are altered to reflect the codons preferred by dicot genes for a particular amino acid. . . For example, in the case of alanine, it can be seen from Table 1 that the codon GCA is used in Bt proteins with a frequency of 50%, whereas the codon GCT is the preferred codon in dicot proteins.

'600 patent, col. 22, lines 25-35 (emphasis added). This statement tends to support Mycogen's definition that there is only one preferred codon per gene for each type of amino acid. However, this same passage goes on to state:

In designing the synthetic Btt gene, not all codons for alanine in the original Bt gene are replaced by GCT; instead, only some alanine codons are changed to GCT while others are replaced with different alanine codons in an attempt to preserve the overall distribution of codons for alanine used in dicot proteins.

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Id., col. 22, lines 35-41. This statement supports the district court's construction because it explains that not all Bt gene alanine codons are replaced with GCT, but other alanine codons may also be used so long as the resulting distribution of codons more closely resembles the dicot distribution (the intended plant host). This implies that GCT is not the only preferred codon in this example. The '600 written description also states:

The percent deviation of the frequency of preferred codon usage for a synthetic gene from that employed by a host cell is calculated first by determining the percent deviation of the frequency of usage of a single codon from that of the host cell followed by obtaining the average

deviation over all codons.

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Id., col. 7, lines 15-20. Again, this statement supports the district court's claim construction. The specified calculation for preferred codon usage measures the difference in frequency of codon usage for each single codon - not just the 20 codons that Mycogen's definition would consider "preferred." Thus, the '600 patent's written description does not provide an explicit definition of the term "preferred codon" that would supersede the plain meaning of the claim terms.

The patent prosecution history is similarly unhelpful in specifying the definition of "preferred codon." During the prosecution of the '862 patent, the patent examiner stated that a reference disclosing the truncation of native Bt genes anticipated a gene with either the "frequency of codon usage" limitation or the "a greater number of codons preferred" limitation. In response, the prosecuting attorney pointed out: "By simple truncation it is impossible to modify a native Bt sequence to yield a truncated sequence that has 'a greater number of codons preferred by a host plant cell.'" (emphasis in original). However, this example would be applicable for either definition of the "greater number of codons preferred" limitation, and thus does not shed additional light on the issue.

Thus, we rely on the plain meaning of the claims. Mycogen chose to use the term "codons preferred" in its claims. Had Mycogen meant the claims to refer to the "most preferred codon" it could have and should have included this limitation in the claims themselves. Furthermore, Mycogen did not indicate or specify in the written description that an individual protein may have only 20 preferred codons, or that a particular protein may have only a single "preferred codon" for each type of amino acid.

Mycogen further argues on appeal that the district court's definition of "greater number of codons preferred" cannot stand because it renders this phrase synonymous with the "frequency of codon usage" limitation in independent claims 7, 8, 19 and 20 of the '600 patent, thus rendering these two sets of claims identical. Under the doctrine of claim differentiation, "[t] here is presumed to be a difference in meaning and scope when different words or phrases are used in separate claims. To the extent that the absence of such difference in meaning and scope would make a claim superfluous, the doctrine of claim differentiation states the presumption that the difference between claims is significant." Tandon Corp. v. United States Int'l Trade Comm'n, 831 F.2d 1017, 1023, 4 USPQ2d 1283, 1288 (Fed. Cir. 1987). Claim 7 of the '600 patent, set forth in its entirety below, is representative of the set of claims at issue:

7. A method of designing a synthetic *Bacillus thuringiensis* gene to be more highly expressed in plants, comprising the steps of:

(a) analyzing the coding sequence of a gene derived from a *Bacillus thuringiensis* which encodes a pesticidal protein toxin;

(b) modifying a portion of said coding sequence to yield a modified sequence which has a frequency of codon usage which more closely resembles the frequency of

codon usage of the plant in which it is to be expressed than did said coding sequence prior to modification, said modification comprising reducing the number of codons having CG in codon positions II and III in a region between plant polyadenylation signals in said coding sequence;

(c) inserting said modified sequence into the genome of a plant cell; and

(d) maintaining said plant cell under conditions suitable to allow replication of said plant cell to produce additional plant cells having said modified sequence in the genome of said additional plant cells, wherein said synthetic *Bacillus thuringiensis* gene is expressed to produce a pesticidal protein toxin.

'600 patent, col. 32, lines 18-41 (emphasis added).

The doctrine of claim differentiation cannot be used to overcome the plain language of the claims themselves. Claims 1 and 7 are separate, independent claims. "It is not unusual that separate claims may define the invention using different terminology, especially where (as here) independent claims are involved." Hormone Research Found., Inc. v. Genentech, Inc., 904 F.2d 1558, 1567 n.15, 15 USPQ2d 1039, 1047 n.15 (Fed. Cir. 1990).

Additionally, the gene truncation example provided in the prosecution history of the '862 patent demonstrates that it would be possible to satisfy independent claim 7 while not satisfying claim 1. The simple truncation of a Bt gene could theoretically "yield a modified sequence which has a frequency of codon usage which more closely resembles the frequency of codon usage of the plant" (the limitation of claim 7) if certain non-plant-like codons were removed. However, such a truncation could not satisfy the district court's definition of the claim 1 "greater number" definition, because it would not result in a higher number of those codons whose frequency in the native Bt gene was lower than their frequency in the intended plant host. This supports the proposition that there is a distinction between the claim constructions given to these two limitations.

Furthermore, the actions of the district court demonstrate that these two claim sets (claims 1 and 7 and their respective dependent claims) were not construed to be identical. For instance, the district court stated in the claim construction decision, "The court finds that these two limitations are slightly different, consistent with Mycogen's representations in the prosecution history." Mycogen claim construction at 25. The proceedings at trial support the premise that the two sets of claims were treated as having separate limitations. For example, all of the claims were submitted separately to the jury; there was no "grouping" of synonymous claims on the jury verdict sheet. Furthermore, the two claim limitations of "greater number of codons preferred" and "frequency of codon usage" were considered separately by the district court in evaluating Monsanto's genes and gene products for infringement in granting Mycogen's motion for JMOL. See Mycogen, 61 F. Supp. 2d at 246-51. In the section of the district court's opinion where these two limitations were analyzed together, any potential error was harmless, as explained in section VI of this opinion. Thus, the district court's claim construction regarding the "greater number of codons preferred" limitation was correct.

One portion of the instructions given to the jury dealt with the doctrine of simultaneous conception and reduction to practice. The jury instructions explaining the doctrine stated:

In some instances, an inventor is unable to establish a conception until he or she has reduced to practice the invention through a successful experiment. This situation results in a simultaneous conception and reduction to practice. You may consider this possibility in reaching your decision on who is the first inventor.

The doctrine of simultaneous conception and reduction to practice is somewhat rare but certainly not unknown, especially in the unpredictable arts such as chemistry and biology. See Burroughs Wellcome Co. v. Barr Labs., Inc., 40 F.3d 1223, 1228-29, 32 USPQ2d 1915, 1920 (Fed. Cir. 1994); Amgen, Inc., 927 F.2d at 1206, 18 USPQ2d at 1021; Smith v. Bousquet, 111 F.2d 157, 159, 45 USPQ 347, 348 (CCPA 1940). Although Burroughs Wellcome specifically notes that the doctrine does not state that an inventor can never conceive of an invention in the unpredictable arts until a reduction to practice has occurred, the doctrine still may apply to cases in such arts.

Mycogen argues that the doctrine may only be applied to inventions embodied in product claims, and not the process and product-by-process claims at issue in the '600 and '862 patents. This is not necessarily so. For example, in regard to the doctrine of simultaneous conception and reduction to practice, Smith states: "The inventor conjectures that some act or material will subserve a given purpose and having tried it finds that it accomplishes the end, and at no time before the successful experiment can it be said that a conception of the invention exists in the inventor's mind." Smith, 111 F.2d at 159, 45 USPQ at 348 (emphasis added). The phrase "some act or material" certainly implies that the doctrine may apply to either method or product claims.

The '600 and '862 patents are directed towards the so-called unpredictable arts, in this case, biology. Furthermore, the claims of the '600 and '862 patents are drafted such that knowledge of the efficacy of the end result of the process is important to the claimed method. For example, claim 1 of the '600 patent states:

1. A method of designing a synthetic *Bacillus thuringiensis* gene to be more highly expressed in plants, comprising the steps of:

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(a) analyzing the coding sequence of a gene derived from a *Bacillus thuringiensis* which encodes a pesticidal protein toxin;

(b) modifying a portion of said coding sequence to yield a modified sequence which contains a greater number of codons preferred by the intended plant host than did said coding sequence prior to modification, said modification comprising reducing the number codons having CG in codon positions II and III in a region between plant polyadenylation signals in said coding sequence;

(c) inserting said modified sequence into the genome of a plant cell; and

(d) maintaining said plant cell under conditions suitable to allow replication of said plant cell to produce additional plant cells having said modified sequence in the genome of said additional plant cells, wherein said synthetic Bacillus thuringiensis gene is expressed to produce a pesticidal protein toxin.

'600 patent, col. 31, lines 37 -57 (emphasis added).

It seems plausible to find that the type of invention embodied in these claims might not have been conceived until it was determined that the process claimed actually did cause Bt to be more highly expressed to produce a pesticidal protein toxin. This would at least suggest the use of the doctrine of simultaneous conception and reduction to practice, and therefore it was proper to instruct the jury on this doctrine.

Mycogen urges us to hold that simultaneous conception and reduction to practice is a legal determination inappropriate for submission to a jury. We decline to so hold. A similar argument with regard to the doctrine of obviousness was made and rejected in Railroad Dynamics, Inc. v. A. Stucki Co., 727 F.2d 1506, 220 USPQ 929 (Fed. Cir. 1984). In Railroad Dynamics, this court stated:

[I]t is neither error nor dangerous to justice to submit legal issues to juries, the submission being accompanied by appropriate instructions on the law from the trial judge. The rules relating to interrogatories, jury instructions, motions for directed verdict, JNOV, and new trial, and the rules governing appeals following jury trials, are fully adequate to provide for interposition of the judge as guardian of the law at the proper point and when necessary.

727 F.2d at 1515, 220 USPQ at 938 (emphasis in original).

There is no dispute that the jury in this case was properly instructed regarding the separate issues of conception and reduction to practice. Because the facts of this case could support a finding that the doctrine of simultaneous conception and reduction to practice applies, it was appropriate in this instance to additionally instruct the jury regarding this doctrine as well. However, we of course do not hold that a jury instruction regarding simultaneous conception and reduction to practice is always applicable; sufficient facts suggesting the applicability of the doctrine must be present in order to warrant such an instruction.

VI

A person is not entitled to a patent if "before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it." 35 U.S.C. § 102(g) (1994). At trial, Monsanto presented evidence demonstrating that Monsanto scientists Drs. Fischhoff and Perlak were prior inventors, i.e., that they invented the subject matter of the '600 and '862 patents before Mycogen. The jury returned a verdict indicating that all of the claims of the '600 and '862 patents were invalid due to prior invention of the subject matter by Monsanto. The district court denied Mycogen's motion for JMOL overturning the finding of prior invention, thereby ruling that there was a legally sufficient evidentiary basis for a

reasonable jury to reach this conclusion. Upon review, this court reapplies the same standard of review:

We review a trial court's decision on a motion for judgment as a matter of law following a jury verdict by reapplying its own standard of review. Therefore, for [a party] to prevail on appeal it must prove that the jury's factual findings were not supported by substantial evidence or that the facts were not sufficient to support the conclusions necessarily drawn by the jury on the way to its verdict.

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Tec Air, Inc. v. Denso Mfg. Mich. Inc., 192 F.3d 1353, 1357, 52 USPQ2d 1294, 1296 (Fed. Cir. 1999) (quoting Applied Med. Res. Corp. v. United States Surgical Corp., 147 F.3d 1374, 1376, 47 USPQ2d 1289, 1290 (Fed. Cir. 1998)). Thus, we review whether or not there was a legally sufficient evidentiary basis for the jury to find that the '600 and '862 patents are invalid due to prior invention.

Mycogen filed the initial patent that matured into the patents at issue on September 9, 1988, thereby constructively reducing the invention to practice. This court has stated that a challenger such as Monsanto has two ways to prove that it was the prior inventor: (1) it reduced its invention to practice first (in this case, before September 9, 1988), or (2) it was the first party to conceive of the invention and then exercised reasonable diligence in reducing that invention to practice. Price v. Symsek, 988 F.2d 1187, 1190, 26 USPQ2d 1031, 1033 (Fed. Cir. 1993). The standard of proof is by clear and convincing evidence. Id. at 1191, 26 USPQ2d at 1033.

At trial, Monsanto's evidence focused upon proving a prior reduction to practice. "In order to establish an actual reduction to practice, the inventor must prove that: (1) he constructed an embodiment or performed a process that met all the limitations of the interference count; and (2) he determined that the invention would work for its intended purpose." Cooper v. Goldfarb, 154 F.3d 1321, 1327, 47 USPQ2d 1896, 1901 (Fed. Cir. 1998). In certain cases, determining that the invention works for its intended purpose will require testing. See Mahurkar v. C.R. Bard, Inc., 79 F.3d 1572, 1578, 38 USPQ2d 1288, 1291 (Fed. Cir. 1996). "[W]hen testing is necessary to establish utility, there must be recognition and appreciation that the tests were successful for reduction to practice to occur." Estee Lauder Inc. v. L'Oreal, S.A., 129 F.3d 588, 594-95, 44 USPQ2d 1610, 1615 (Fed. Cir. 1997).

The first prong of the reduction to practice test refers to "the interference count" because Cooper dealt with the appeal of an interference proceeding. The issues of priority and reduction to practice typically arise in this court through the appeal of an interference proceeding, in which the Patent and Trademark Office ("PTO") determines priority of invention between two or more parties claiming the same patentable invention. See 35 U.S.C. § 135 (1994); 37 C.F.R. § 1.601(i) (2000). A "count" defines the interfering subject matter, and each count corresponds to a separate patentable invention. See 37 C.F.R. § 1.601(f) (2000). A count is created to define the interfering subject matter between two or more applications or between one or more applications and one or more patents. See id. A count may be identical to a single claim at issue, or it may be broader in scope than the particular claims at issue. See id.

In rare cases, an interference between issued patents may be initiated in district court under

the "Interfering patents" section of the patent statute, which provides for a civil action in such cases. See 35 U.S.C. § 291 (1994). These cases involve two or more issued patents, and may invoke issues of inventorship and reduction to practice. See, e.g., Environ Prods., Inc. v. Furon Co., 215 F.3d 1261, 55 USPQ2d 1038 (Fed. Cir. 2000); Slip Track Sys., Inc. v. Metal Lite, Inc., 159 F.3d 1337, 48 USPQ2d 1055 (Fed. Cir. 1998). Section 291 proceedings require a comparison of the claims of the issued patents, not of their disclosures. Advance Transformer Co. v. Levinson, 837 F.2d 1081, 1083, 5 USPQ2d 1600, 1602 (Fed. Cir. 1988).

The case before us does not fall into either category. It is not an appeal of a section 135 interference proceeding, and it does not involve a section 291 action. Instead, we are comparing two issued Mycogen patents, the '600 and '862 patents, with the work performed by Monsanto's scientists. Without the benefit of written claims for the Monsanto efforts, it is difficult to develop a "count" encompassing both party's inventions, as would commonly be done in an interference proceeding.

In this situation, it is therefore appropriate to place the focus of inquiry upon the specific claims of the '600 and '862 patents as representing the invention at issue. These claims may then be used to determine whether or not the work performed by Monsanto constitutes a reduction to practice that meets the limitations of the claimed invention. In Amgen, Inc. v. Chugai Pharmaceutical Co., which also involved a section 102(g) priority determination between an issued patent and a scientist's work, the focus of the inquiry was upon the invention recited in the patent's claims. Amgen, Inc., 927 F.2d at 1206, 18 USPQ2d at 1021.

As noted previously, the claims of the '600 patent encompass a method of designing a synthetic *Bacillus thuringiensis* gene to be more highly expressed in plants. Claims 1 and 7 are identical except for the difference between the "greater number of codons preferred" and the "frequency of codon usage" limitations previously discussed. Both claims 1 and 7 include a limitation regarding a specific modification that reduces the number of codons having the CG nucleotides:

1. A method of designing a synthetic *Bacillus thuringiensis* gene to be more highly expressed in plants, comprising the steps of:

(a) analyzing the coding sequence of a gene derived from a *Bacillus thuringiensis* which encodes a pesticidal protein toxin;

(b) modifying a portion of said coding sequence to yield a modified sequence which contains a greater number of codons preferred by the intended plant host than did said coding sequence prior to modification, said modification comprising reducing the number codons having CG in codon positions II and III in a region between plant polyadenylation signals in said coding sequence;

(c) inserting said modified sequence into the genome of a plant cell; and

(d) maintaining said plant cell under conditions suitable to allow replication of said plant cell to produce additional plant cells having said modified sequence in the genome of said additional plant cells, wherein said synthetic *Bacillus thuringiensis* gene is expressed to produce a pesticidal protein toxin.

'600 patent, col. 31, lines 37-57 (emphasis added).

Claims 3 and 4 elaborate on the percentage of codons or nucleotides modified from the native Bt gene:

3. The method of claim 1, wherein at least about 32% of the codons in the coding sequence of the native *Bacillus thuringiensis* gene have been modified to yield said synthetic gene.

4. The method of claim 1, wherein at least about 11% of the nucleotides in the coding sequence of the native *Bacillus thuringiensis* gene have been changed to yield said synthetic gene.

'600 patent, col. 32, lines 3-10.

Claim 2 of the '600 patent encompasses a DNA coding sequence produced by following steps (a) and (b) of claim 1, and claims 5 and 6 add the limitations of claims 3 and 4, respectively, to claim 2. Claims 8-12, which depend from independent claim 7, are substantially similar to the claims depending from claim 1.

Claims 13 and 19 are identical except for the difference between the "greater number of codons preferred" and the "frequency of codon usage" limitations. Claims 13 and 19 differ from claims 1 and 7, respectively, because they include a limitation regarding a specific modification resulting in fewer occurrences of the nucleotide sequence AATGAA:

13. A method of designing a synthetic *Bacillus thuringiensis* gene to be more highly expressed in plants, comprising the steps of:

(a) analyzing the coding sequence of a gene derived from a *Bacillus thuringiensis* which encodes a pesticidal protein toxin;

(b) modifying a portion of said coding sequence to yield a modified sequence which contains a greater number of codons preferred by the intended plant host than did said coding sequence prior to modification, and wherein said modification results in fewer occurrences of the sequence AATGAA in said modified sequence than in said coding sequence;

(c) inserting said modified sequence into the genome of a plant cell; and

(d) maintaining said plant cell under conditions suitable to allow replication of said plant cell to produce additional plant cells having said modified sequence in the genome of said additional plant cells, wherein said synthetic *Bacillus thuringiensis* gene is expressed to produce a pesticidal protein toxin.

'600 patent, col. 33, lines 3-23.

The remainder of the claims in the '600 patent involve combinations of the limitations discussed above. The claims of the '862 patent are very similar to the '600 patent, and follow the same basic structure. The '862 patent essentially claims the plant cells, progeny cells, and seeds of the synthetic Bt gene created by the method of the '600 patent. Claims 1-5 are representative:

1. A plant cell comprising a heterologous modified structural gene derived from a *Bacillus thuringiensis* gene encoding a pesticidal protein toxin, said plant cell produced by the steps of

(a) analyzing the coding sequence of a gene derived from a *Bacillus thuringiensis* which encodes a pesticidal protein toxin;

(b) a portion of said coding sequence to yield a modified structural gene which contains a greater number of codons preferred by said plant cell than did said coding sequence prior to modification, said modification comprising reducing the number of codons having CG in codon positions II and III in a region between plant polyadenylation signals in said coding sequence;

(c) inserting said modified structural gene into the genome of a plant cell; and

(d) maintaining said plant cell under conditions suitable to allow replication of said plant cell to produce additional plant cells having said modified structural gene the genome of said additional plant cells, wherein said modified structural gene is expressed to produce a pesticidal protein toxin.

2. Progeny cells of the cell of claim 1.

3. A plant comprising progeny cells according to claim 2.

4. A progeny plant of the plant of claim 3.

5. A seed of a plant of claim 3 or claim 4.

'862 patent, col. 30, line 51 – col. 31, line 10.

The district court's opinion identified three "key limitations" of the claims of the '600 and '862 patents:

(1) The frequency limitation, that is, the requirement that the frequency of codon usage of the synthetic *Bt* gene more closely resemble that of the intended plant host;

(2) The XCG limitation,¹ that is, the requirement that at least one XCG codon be removed when designing the synthetic *Bt* gene; and

(3) The AATGAA limitation, that is, the requirement that at least one AATGAA sequence be removed when designing the synthetic *Bt* gene.

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Mycogen, 61 F. Supp. 2d at 238.

The district court then performed an analysis of whether the work performed by Monsanto

satisfied these three "key limitations." However, the claims of the '600 and '862 patent also include additional limitations. For instance, several claims, including claim 1 of the '600 patent, require one to perform the following steps: 1) analyze the coding sequence of a Bt gene; 2) modify the coding sequence; 3) insert the modified sequence into the genome of a plant cell; and 4) maintain the plant cell . . . to produce additional plant cells. Additionally, claims 3 and 4 of the '600 patent require at least about 32 percent of the codons or 11 percent of the nucleotides (respectively) in the Bt gene to be modified. It would seem that the comparison should also consider these limitations.

However, these additional limitations present in the claims but not identified as "key limitations" appear not to be areas of dispute. "The parties do not dispute, and the record shows, that Fischhoff and Perlak at Monsanto designed, built and tested synthetic Bt genes that contained the structure claimed in Mycogen's patents before Mycogen filed its patent applications on September 9, 1988." Mycogen, 61 F. Supp. 2d at 239. The evidence of record shows that Monsanto's synthetic Bt genes were inserted into plants, which were then grown and successfully tested for increased Bt expression in early- to mid-August 1988. Id. at 222.

Thus, for purposes of our prior invention discussion, it is sufficient to focus upon the three "key limitations" identified by the district court. We note that in light of our prior discussion concerning the "greater number" and "frequency of codon usage" limitations of claims 1 and 7, it would have been preferable to treat these as separate "key limitations" instead of melding them both into the first "key limitation." However, as the controversy surrounding the prior invention issue does not relate to the distinction between these two limitations, any potential error resulting from treating these two different limitations as a single "key limitation" was harmless.

Mycogen does not dispute that the genes and resulting plants created and successfully tested by Monsanto's scientists prior to Mycogen's date of constructive reduction to practice met all of the limitations of the product claims of the '600 and '862 patents. Nor does Mycogen dispute that the methods employed by Monsanto's scientists to make these genes and plants met the limitations of the process claims of the '600 and '862 patents. Thus, we agree with the district court that the portion of the reduction to practice test requiring that all limitations of the count be met has been satisfied.

The precise language of the reduction to practice test states "[i]t is well-settled that conception and reduction to practice cannot be established nunc pro tunc. There must be contemporaneous recognition and appreciation of the invention represented by the counts." Breen v. Henshaw, 472 F.2d 1398, 1401, 176 USPQ 519, 521 (CCPA 1973) (emphasis added); see also Estee Lauder, 129 F.3d at 593, 44 USPQ2d at 1614 (summarizing past cases by stating "[t]hese cases trumpet, therefore, the principle that a reduction to practice does not occur until the inventor has determined that the invention will work for its intended purpose").

The purpose of the invention was to produce a pesticidal protein toxin in plants through the higher expression of the Bt gene. The record and the district court's opinion clearly show that Monsanto appreciated that the invention worked for this purpose. Monsanto tested the plants resulting from their modified genes specifically looking for the presence of increased Bt protein. See Mycogen, 61 F. Supp. 2d at 222. Moreover, the Monsanto scientists, upon learning of the

test results indicating that their gene caused increased Bt expression, immediately appreciated the significance of the results. The analyst in charge of the testing testified that the test results "proved that we [Monsanto] had succeeded, that the synthetic gene worked and worked exceptionally well in plants." Id. at 240 (alteration in original).

Mycogen argues that at the time of reduction to practice, the Monsanto inventors did not have an appreciation of the claimed methods for producing a Bt gene with improved expression, or a contemporaneous understanding that they had synthesized their gene using any of the processes claimed in the patents. Mycogen further urges that without such an appreciation of the claimed methods, there cannot have been a true reduction to practice.

Mycogen's arguments appear to touch upon the related doctrine of accidental anticipation. Past cases have indicated that accidental, unappreciated results should not be regarded as anticipatory. See, e.g., Tilghman v. Proctor, 102 U.S. 707, 711-12 (1880) (stating that results that were "accidentally and unwittingly produced" do not anticipate future discoveries); Eibel Process Co. v. Minn. & Ont. Paper Co., 261 U.S. 45, 66 (1923) (stating that "accidental results, not intended and not appreciated, do not constitute anticipation").

It follows that an accidental, unappreciated reduction to practice should not constitute a "true" reduction to practice for the purposes of determining priority of invention or anticipation pursuant to section 102(g). However, there is no evidence that the reduction to practice performed by Monsanto was in any way accidental. The work performed by Monsanto scientists that led to the reduction to practice of genes meeting the limitations of the '600 and '862 claims was part of a research program specifically directed towards finding a synthetic gene capable of improved Bt expression. Monsanto had begun work in this area in 1984, several years prior to its reduction to practice. See Mycogen, 61 F. Supp. 2d at 221. Therefore, Monsanto's invention of the genes causing increased Bt expression was in no way an accident.

The main focus of Mycogen's argument regarding reduction to practice is the precise language of certain claim limitations. Mycogen on appeal argues that the Monsanto inventors "did not conceive of or intentionally use a process that involved modifying the codon frequency of native Bt to make it closer to that of the intended plant host. Instead, Monsanto's process was to reduce 'A' and 'T' nucleotide content and reduce the presence of certain nucleotide sequences that inhibited the Bt gene's expression in plants." This argument relates to the first "key limitation," which states "the requirement that the frequency of codon usage of the synthetic Bt gene more closely resemble that of the intended plant host." Mycogen makes similar arguments regarding the other two "key limitations" that the Monsanto inventors did not appreciate either the removal of XCG codons or the removal of the AATGAA sequence.

First, we note that Monsanto is not required to have framed its prior documentation about its reduction to practice in the exact language given in the claims. "The invention is not the language of the count but the subject matter thereby defined." Silvestri v. Grant, 496 F.2d 593, 599, 181 USPQ 706, 710 (CCPA 1974). The reduction to practice test does not require in haec verba appreciation of each of the limitations of the count. The fact that Monsanto may have described parts of its process in terms of "nucleotides" instead of "codons" is immaterial. The two terms are not unrelated - a codon is a set of three nucleotides. A process describing the modification of certain codons may also be described in terms of nucleotides.

Furthermore, the district court's opinion cites to several instances of specific testimony by

Monsanto inventors indicating that they did contemporaneously appreciate the three "key limitations" of the claims of the invention. For example, with regard to the frequency limitation, Monsanto scientist Fischhoff testified that he and Monsanto inventor "Perlak 'sought to reduce the frequency of codons that rarely occurred in plant genes' and to 'increase the frequency of codons that were utilized more in plant genes.'" Mycogen, 61 F. Supp. 2d at 239 (alterations omitted). Perlak also testified regarding his usage of a codon usage table developed at Monsanto which guided him "toward plant preferred codons." Id.

With regard to the XCG and AATGAA limitations, both Fischhoff and Perlak testified that they derived the idea to reduce the number of XCG codons in their synthetic Bt genes from Monsanto's codon usage table. See id. Fischhoff also testified that during the development of the genes eventually successfully tested at Monsanto, he and Perlak removed AATGAA sequences and XCG codons "as part of [their] solution." Id. at 240 (alterations in original).

The above testimony, and additional testimony cited in the district court's opinion, constitutes a legally sufficient evidentiary basis for a reasonable jury to find that Monsanto's scientists appreciated the limitations of the claims of the '600 and '862 patents. Although the amount of evidence regarding appreciation of each specific claim limitation is not extensive, we find that it is legally satisfactory, particularly in light of the extensive evidence establishing that Monsanto performed a process that met all of the limitations of the claims, and that the resulting product was successfully tested and appreciated to work for its intended purpose. Furthermore, Monsanto's actions were clearly performed deliberately, with no suggestion of accidental invention.

VII

The district court's denial of Mycogen's motion for JMOL overturning the jury's verdict of noninfringement due to patent invalidity pursuant to 35 U.S.C. § 102(g) is affirmed. Because this decision renders the '600 and '862 patents invalid, we do not address the related appeal of the district court's grant of JMOL that the patents are invalid due to lack of enablement. Similarly, the district court's denial of Mycogen's motion for a new trial based upon inconsistent jury verdicts is affirmed, and the district court's claim construction is also affirmed. Additionally, the correctness of the jury instructions regarding the doctrine of simultaneous conception and reduction to practice is affirmed.

Our ruling affirming patent invalidity renders both cross-appeals moot.

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COSTS

No costs.

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AFFIRMED

FOOTNOTES:

[1] There are 61 codons because a codon is a sequence of three nucleotides. For mRNA, there are four nucleotide possibilities, A, G, C and U. Thus, three nucleotides, each consisting of four possibilities, A, G, C or U, are represented mathematically as 4^3 ($4 \times 4 \times 4$), which equals 64 possible codons. Of the 64 possible codons, however, three codons, UAA, UAG and UGA, do not correspond to amino acids. Thus, there are 61 codons. See, e.g., McGraw-Hill Encyclopedia of Science & Technology, "Gene" at Vol. 7, page 740 (1997). For general information on genetics, see In re O'Farrell, 853 F.2d 894, 895-99, 7 USPQ2d 1673, 1674-77 (Fed. Cir. 1988).

[2] Scientists variously refer to this as "redundancy" or "degeneracy" in the genetic code. The term "unique" refers to an amino acid coded by only a single codon. See, e.g., Amgen, Inc. v. Chugai Pharm. Co., 927 F.2d 1200, 1207-08 n.4, 18 USPQ2d 1016, 1022 n.4 (Fed. Cir. 1991).

[3] The "X" is a generic placeholder in the codon description, for example, XCG refers to any codon with CG in codon positions II and III.