



(12) 发明专利申请

(10) 申请公布号 CN 103403169 A

(43) 申请公布日 2013. 11. 20

(21) 申请号 201180068506. 0

(74) 专利代理机构 永新专利商标代理有限公司
72002

(22) 申请日 2011. 12. 07

代理人 王健

(30) 优先权数据

61/446, 460 2011. 02. 24 US

(51) Int. Cl.

C12N 15/82 (2006. 01)

(85) PCT申请进入国家阶段日

2013. 08. 26

C12N 15/29 (2006. 01)

A01H 5/00 (2006. 01)

(86) PCT申请的申请数据

PCT/US2011/063850 2011. 12. 07

A01H 5/10 (2006. 01)

(87) PCT申请的公布数据

W02012/115697 EN 2012. 08. 30

(71) 申请人 衣阿华州立大学研究基金公司

地址 美国衣阿华州

(72) 发明人 L·李 E·S·维特勒

权利要求书1页 说明书37页

序列表1页 附图2页

(54) 发明名称

改变植物中生物化学成分的材料和方法

(57) 摘要

本发明提供了改变植物中至少一种生物化学成分,例如蛋白质,脂质(如油)和/或碳水化合物(如淀粉)的量的方法,包括在野生型不表达Qua-Quine Starch(QQS)的植物中以改变所述植物中至少一种化学成分的量(或水平)表达QQS;转基因植物或者其部分,其包含和表达作为转基因的QQS并且其中至少一种生物化学成分的量被改变;所述转基因植物的可再生细胞的组织培养物;包含编码QQS编码序列的核苷酸序列的载体,所述核苷酸序列与促进所述核苷酸序列在植物中表达的非天然启动子可操纵地连接,所述植物是除拟南芥属(Arabidopsis)之外的植物;以及从植物中生产食品或工业产物的方法,包括从栽培的转基因植物或者从转基因植物(或者其部分)的可再生细胞的组织培养物再生的栽培植物制备食品或工业产物,其中所述转基因植物包含和表达作为转基因的QQS,其中至少一种生物化学成分的量被改变。

1. 一种改变植物中至少一种生物化学成分的方法,所述方法包括在野生型 (WT) 不表达 Qua-Quine Starch (QQS) 的植物中以改变所述植物中至少一种生物化学成分的量表达 QQS,由此改变所述植物中至少一种生物化学成分的量。

2. 权利要求 1 的方法,其中所述至少一种生物化学成分选自蛋白质、脂质和碳水化合物。

3. 权利要求 2 的方法,其中所述脂质是油和 / 或所述碳水化合物是淀粉。

4. 权利要求 1 的方法,其中所述至少一种生物化学成分是蛋白质并且表达 QQS 的植物种子中所述蛋白质的量与 WT 植物种子中所述蛋白质的量相比增加,所述至少一种生物化学成分是油并且表达 QQS 的植物种子中所述油的量与 WT 植物种子中所述油的量相比降低,和 / 或所述至少一种生物化学成分是碳水化合物并且表达 QQS 的植物的叶、种子或者叶和种子中所述碳水化合物的量分别与 WT 植物的叶、种子或者叶和种子中所述碳水化合物的量相比降低。

5. 权利要求 1 的方法,其中所述植物是大豆。

6. 权利要求 5 的方法,其中所述至少一种生物化学成分是蛋白质并且所述大豆种子中蛋白质的量与 WT 大豆种子中蛋白质的量相比增加至少大约 30%,所述至少一种生物化学成分是蛋白质并且所述大豆种子中蛋白质的量与 WT 大豆种子中蛋白质的量相比增加至少大约 45%,和 / 或所述至少一种生物化学成分是蛋白质并且所述大豆种子中蛋白质的量与 WT 大豆种子中蛋白质的量相比增加至少大约 60%。

7. 转基因植物或者其部分,其包含并且表达作为转基因的 QQS,其中至少一种生物化学成分以与不表达 QQS 的相应 WT 植物或者其部分中存在的量不同的量存在。

8. 权利要求 7 的植物或者其部分,其中所述植物是大豆。

9. 权利要求 7 或 8 的转基因植物的可再生细胞的组织培养物。

10. 包含编码 QQS 编码序列的核苷酸序列的载体,所述核苷酸序列与促进核苷酸序列在植物中表达的非天然启动子可操纵地连接,其中所述植物是除拟南芥属 (*Arabidopsis*) 之外的植物。

11. 权利要求 10 的载体,其中所述核苷酸序列编码 SEQ ID NO:2 所示氨基酸序列。

12. 权利要求 11 的载体,其中所述核苷酸序列是 SEQ ID NO:1。

13. 权利要求 10 的载体,其中所述启动子是组成型启动子、诱导型启动子、发育特异性启动子、合成启动子或者杂种启动子。

14. 权利要求 13 的载体,其中所述组成型启动子是花椰菜花叶病毒 35S 启动子或者发育特异性启动子是种子特异性启动子。

15. 从植物中生产食品或者工业产物的方法,所述方法包括从栽培的权利要求 7 或 8 的转基因植物中或者从其可再生细胞的组织培养物中再生的栽培的植物中制备食品或工业产物,由此生产来自植物的食品或工业产物。

改变植物中生物化学成分的材料和方法

[0001] 相关申请的交叉参考

[0002] 本申请要求 2011 年 2 月 24 日申请的共有未决美国临时申请号 61/446,460 的优先权,其以全部内容援引加入本文。

[0003] 联邦资助的研发声明

[0004] 本文公开的发明是在美国政府资助下完成的,资助是由国家科学基金提供的基金号 MCB0209789 和 MCB0951170。政府在本发明中有一定权利。

技术领域

[0005] 本发明涉及改变植物、特别是农作物中至少一种生物化学成分的量材料和方法。植物叶和 / 或种子中碳水化合物如淀粉的量以及植物种子中蛋白质和 / 或脂质如油的量可以根据本发明进行改变。特别地,本发明涉及植物 (或者其部分) 中、特别是农作物中 Qua-Quine Starch(QQS) 的表达,该植物的 WT 不表达 QQS。

[0006] 发明背景

[0007] 植物贮存产物包括淀粉、脂质和蛋白质。不同的植物物种其贮存产物的种类和相对比例不同。例如,谷物种子主要包含淀粉,而油料种子主要包含油,其它种子如大豆种子主要包含蛋白质。

[0008] 产生淀粉、脂质和蛋白质的途径由关键的中间产物联系起来。例如,己糖如葡萄糖是淀粉合成的前体及淀粉降解的终产物。己糖也可以转变为丙酮酸,其可导致 (i) 乙酰 -CoA 和丙二酰 -CoA 的产生,以进行脂肪酸从头合成、脂肪酸延长、聚酮化合物形成及类异戊二烯合成以及 (ii) 氨基酸的生物合成。

[0009] 改变植物、特别是农作物的贮存产物的能力是植物育种学家及应用重组 DNA 技术的那些人的目标。Mike Rankin,威斯康星大学 (UW) 的农作物和土壤机构 (Crops and Soils Agent for the University of Wisconsin),最近报道了 UW 的大豆学专家 Roger Borgers 指出了一个好的例子,即低蛋白质大豆由于美国大豆 (其是相对低蛋白质的) 的折扣定价而在全球市场上使整个大豆产业付出代价 (www.uwex.edu/ces/crops/SoyProtein.htm)。根据在 UW 的那些人,来自南美洲的大豆价值更高,并因此定价。据报道,一蒲式耳美国大豆产生 21 磅蛋白质和 11.4 磅油,而巴西大豆产生 24 磅蛋白质和 13 磅油。Rankin 认为需要更注重开发具有更高蛋白质含量的品种,特别是鉴于在美国地理区域内 (0.6-2.0%,根据年份) 及品种间 (在威斯康辛州 32.3%-38.1%) 大豆蛋白质含量的大的差异。在这方面,西部 Corn Belt 和威斯康辛州以及美国其它区域如东南部并无进展。重要的是产量不随着较高的蛋白质和油含量而降低。在这方面,Baker et al. (Poultry Science 90:390-395 (2011)) 报道了从高蛋白或低寡糖大豆品种产生的大豆粉较从常规大豆品种中产生的大豆粉具有更高的营养价值,因此可以以更少量喂养肉鸡。

[0010] 近来,发现 qua-quine starch(QQS) 基因 (基因座 ID At3g30720;GenBank 登录号 EU805808.1 和 NM_113075.4) 对拟南芥属植物中植物生物化学成分有作用。QQS 基因编码含有 59 个氨基酸的蛋白质,无已知功能,与拟南芥属植物或其它生物体中其它蛋白质无序

列相似性,无已知催化基序,以及无已知结构基序。对 QQS 启动子的分析表明其在 -734 位置具有 CCA1 结合位点基序 (AAAAATCT),在 -504 位置具有 TGA1 结合位点基序 (TGACGTGG ; bZip 转录因子功能),在 -504 位置具有 UPRMOTIFIAT 基序 (TGACGTGG ;未折叠蛋白质应答),在 -503 位置具有 ABRE- 样结合位点基序 (GACGTGGC ;ABA 功能),及在 -502 位置具有 ACGTABREMPTIFA20SEM 基序 (ACGTGGC ;ABA 功能)。在野生型 (WT) 拟南芥属植物花粉发育期间(从单核小孢子至两细胞花粉至三细胞花粉至成熟花粉)QQS RNA 转录物增加,在成熟花粉中达到峰值水平。在野生型 (WT) 拟南芥属植物中,使用 β -葡萄糖醛酸糖苷酶 (GUS) 基因报道系统确定的 QQS 启动子的活性在胚轴和根尖中在吸涨后 (DAI) 2 天是明显的。随着幼苗生长,QQS 表达扩展到维管结构,叶肉细胞,排水器,和叶片及叶柄的表皮毛。显微解剖表明在茎分生组织中检测到无表达;茎尖中深色 GUS 染色与相邻的维管结构相关。GUS 活性在成熟叶中比在幼生叶中高;其一致地呈现一定程度的不均匀分布,并且主要位于维管结构中;这个模式在整个发育期间均保持。QQS 表达在花芽中低;但是到开花时,QQS 表达在花梗、萼片、花丝、成熟花粉、柱头和花柱中明显,但在花瓣中不明显。在长角果发育期间,在柱头和花柱中的 QQS 表达升高,并且在长角果壁和花托的全部母体组织中变得明显。QQS 在整个发育中在根中表达。表达在根尖中特别是在根冠、柱状细胞(columella cells)和 peripheral cap 最高,在根分生组织区域程度较低,但是在表皮中无表达。QQS 在其出现期间在侧根起始部位、在根尖及维管结构中表达;随着侧根成熟,在全部根皮层维管结构中可检测到表达。在基本上所有条件下,由 QQS 启动子驱动的 GUS 活性在 Atss3(淀粉合酶 3)单突变体中比在野生型中更高。表达可在 2DAI 的完整幼苗中及后来发育中可检测到,特别是在叶、花和根中。尽管 Atss3 突变体和野生型中的一般表达模式是相似的,在 Atss3 突变体中 QQS 在花瓣中异位表达。QQS RNA 在核及质体中均不积累。在 Atss2/Atss3 双突变体背景中的 QQS 启动子 - GUS 表达更有细微差别,但是总的来说类似于或者稍低于野生型中整个叶发育期间的表达。与野生型拟南芥相比,Atss3 突变体中的昼夜循环期间的 QQS 转录物增加 7 倍;Atss3 突变体中的 QQS 蛋白质水平也比野生型拟南芥中增加。QQS RNAi(干扰 RNA)突变体的分析示出在光照循环结束时淀粉含量增加 20-30%(在 Atss3 突变体中观测到大致相同的增加),这是由于淀粉生物合成增加及淀粉降解未降低所致;在黑暗循环结束时淀粉含量无差异。在黑暗循环的四小时内淀粉含量降低至 WT 水平。所有上述实例均在 Li et al., Plant Journal 58:485-498(2009) 中描述。

[0011] 鉴于前述内容,本发明的一个目的是提供改变植物中至少一种生物化学成分的材料和方法。本发明的这个及其它目的和优势以及发明特征通过在此提供的详细描述而显而易见。

[0012] 发明概述

[0013] 本发明提供了一种改变植物中至少一种生物化学成分的方法。所述方法包括在植物中以改变所述植物中至少一种生物化学成分的量表达 Qua-Quine Starch(QQS),所述植物的 WT 不表达 QQS。所述生物化学成分可以是蛋白质、脂质(例如油)、聚酮化合物、类异戊二烯和/或碳水化合物(如淀粉)。当所述生物化学成分是蛋白质时,表达 QQS 的植物种子中蛋白质的量与 WT 植物种子中蛋白质的量相比是增加的。当所述生物化学成分是油时,表达 QQS 的植物种子中油的量与 WT 植物种子中油的量相比是降低的。当所述生物化学成分是淀粉时,表达 QQS 的植物叶中淀粉的量与 WT 植物叶中淀粉的量

相比是降低的。

[0014] 当所述植物是大豆及所述生物化学成分是蛋白质时,大豆种子中蛋白质的量与 WT 大豆种子中蛋白质的量相比可增加至少大约 30%。所述大豆种子中蛋白质的量可以增加至少大约 45%,如至少大约 60%。

[0015] 鉴于上述内容,本发明还提供了转基因植物或者其部分,其包含和表达作为转基因的 QQS。在转基因植物或者其部分中,至少一种生物化学成分以与在不表达 QQS 的相应 WT 植物或其部分中存在的量不同的量存在。所述转基因植物或者其部分可以是大豆。

[0016] 也鉴于上述内容,本发明提供了转基因植物(或其部分)的可再生细胞的组织培养物,其包含和表达作为转基因的 QQS。所述转基因植物中至少一种生物化学成分以与在不表达 QQS 的相应 WT 植物或其部分中存在的量不同的量存在。

[0017] 本发明进一步提供了载体。所述载体包含编码 QQS 编码序列的核苷酸序列,与促进所述核苷酸序列的氨基酸序列在植物中表达的非天然启动子可操纵地连接,其中所述植物是拟南芥属植物之外的植物。所述核苷酸序列优选编码 SEQ ID NO:2 所示氨基酸序列。这种核苷酸序列的实例是 SEQID NO:1。所述启动子可以是任何合适的启动子,如组成型启动子,如花椰菜花叶病毒 35S 启动子,诱导型启动子,发育特异性启动子,如种子特异性启动子,或者合成启动子,如杂种启动子。

[0018] 本发明还进一步提供了一种从植物中产生食品或工业产物的方法。所述方法包括从栽培的转基因植物中或者从转基因植物(或其部分)的可再生细胞的组织培养物再生的栽培的植物中制备食品或工业产物。所述转基因植物包含及表达作为转基因的 QQS。所述转基因植物中至少一种生物化学成分以与在不表达 QQS 的相应 WT 植物或其部分中存在的量不同的量存在。虽然所述转基因植物或其部分可以是其中生物化学成分的量改变是希望的(如上所述)任何植物,优选植物是大豆。

[0019] 附图简述

[0020] 图 1a 是拟南芥(*Arabidopsis thaliana*) Qua-Quine Starch (QQS) cDNA 的核苷酸序列 [SEQ ID NO:1]。

[0021] 图 1b 是拟南芥 QQS 蛋白的氨基酸序列 [SEQ ID NO:2]。

[0022] 图 2 是转基因大豆品系与 WT (Williams82) 大豆的淀粉含量 (mg/g 鲜重)、油 (% 干重) 和蛋白质 (% 干重) 的对比柱状图。

[0023] 图 3 是在除拟南芥属之外的植物中表达 QQS 的载体 (QQS-OEAt3g30720) 的构建图,其中 Hpa I、Stu I 和 Apa I 是限制性核酸内切酶位点,Sm/SpR 是壮观霉素抗性基因,LB 是左转移 DNA 边界,Bar 是赋予除草剂双丙氨膦抗性的基因,p35S 是花椰菜花叶病毒 (CaMV) 35S 启动子,attB1 和 attB2 是 Gateway DNA 重组位点 B1 和 B2,T35S 是 CaMV35S 启动子的终止子,RB 是右转移 DNA 边界,QQS CDS 是 QQS 编码序列 (180 个核苷酸,SEQ ID NO:1 的第 301-480 位核苷酸)。

[0024] 发明详述

[0025] 本发明至少部分基于令人惊奇及未曾预料地发现编码含有 59 个氨基酸的蛋白质的 qua-quine starch (QQS) 基因 (基因座标签 At3g30720; GenBank 登录号 EU805808.1 和 NM_113075.4) 对拟南芥属中生物化学成分起作用,与拟南芥属或其它生物体中其它蛋白质无序列相似性,无已知催化基序及无已知结构基序,以及对其它植物中生物化学成分起作用

用。通过在植物中表达 QQS 以改变植物中至少一种生物化学成分的量使得可以不用进行广泛的育种研究而产生具有更希望的生物化学成分组合物的植物品系。

[0026] 鉴于上述内容,本发明提供了一种改变植物中至少一种生物化学成分的方法。所述方法包括在植物中以改变所述植物中至少一种生物化学成分的量(即有效量,如生物化学成分改变量)或水平(即有效水平,如生物化学成分改变水平)表达 QQS,所述植物的 WT 不表达 QQS。当 QQS 在植物(其野生型不表达 QQS)中表达及植物中至少一种生物化学成分的量被改变时,QQS 在植物中以改变植物中至少一种生物化学成分的量或水平表达。所述方法可用于产生供人消费的食品(或者其成分或配料)、供非人动物消耗的饲料(或者其成分或配料),或者工业产物(即任何及所有非食品,或者其成分或配料),如根据本发明所述方法产生。在这方面,如下文所述,“生物化学成分”如其量增加的生物化学成分或者其中生物化学成分的量增加/降低的植物(或者其部分)可以是食品(或者其成分或配料)、饲料(或者其成分或配料),或者工业产物(或者其成分或配料)。

[0027] “生物化学成分”是指植物的组成的任何部分(例如碳部分,氮部分,磷部分,或者离子部分),包含所述部分的任何类别的化合物/离子(例如碳部分的多糖、糖、有机酸、酚、鞣酸、半纤维素、脂质、萜类、纤维素和木质素;氮部分的蛋白质、氨基酸、生物碱、硝酸盐/酯和核酸;磷组分的磷酸盐/酯,多磷酸盐/酯,磷脂,核酸和糖磷酸酯;及离子部分的钾、钙、镁、盐和重金属),以及构建在植物中的并且可以被动员以支持生物合成进行生长或其它植物功能的化合物类别所包含的任何化合物(见例如 Chapin, III et al., Ann. Rev. of Ecology and Systematics 21:423-447 (1990) 及其中列举的参考文献,所有文献均以其全文援引加入本文)。举例的植物脂质类别包括中性脂质,如三酰甘油、二酰甘油和单酰甘油,极性脂质,如单半乳糖基二酰甘油、二半乳糖基二酰甘油、磷脂酰甘油、磷脂酰胆碱、磷脂酰乙醇胺、磷脂酰肌醇、磷脂酰丝氨酸及硫代异鼠李糖二酰甘油。一般的植物脂肪酸包括棕榈酸、棕榈油酸、palmitolenic acid、硬脂酸、油酸、亚油酸、亚麻酸、花生酸、二十烯酸、二十碳二烯酸和芥子酸。“生物化学成分”涵盖可以通过一或多种类型贮存过程形成的化合物(如淀粉和氨基酸),及可提供贮存和非贮存作用的化合物(例如二磷酸核酮糖羧化酶(RUBISCO)和鞣酸)。所述生物化学成分可以是蛋白质、脂质(例如油)、聚酮化合物、类异戊二烯,和/或碳水化合物(例如淀粉)。

[0028] “改变”是指增加或降低生物化学成分的量。在这方面,QQS 在植物中的表达可以通过增加一或多种生物化学成分的量、降低一或多种生物化学成分的量、或者同时增加一或多种生物化学成分的量及降低一或多种其它生物化学成分的量而改变一或多种生物化学成分。因此,所述生物化学成分可以是蛋白质,例如表达 QQS 的植物的种子中蛋白质的量与 WT 植物种子中蛋白质的量相比可增加。此外或或者,所述生物化学成分可以是脂质(如油),例如表达 QQS 的植物的种子中脂质(如油)的量与 WT 植物种子中脂质(如油)的量相比可降低。再者,此外或或者,所述生物化学成分可以是碳水化合物(例如淀粉),例如表达 QQS 的植物的叶、种子或者叶和种子中碳水化合物(例如淀粉)的量分别与 WT 植物的叶、种子或者叶和种子中碳水化合物(例如淀粉)的量相比可降低。至少一种生物化学成分的量可以被改变,如增加或降低至少大约 5%、10%、15%、20%、25%、30%、35%、40%、45%、50%、55%、60%、65%、70%、75%、80%、85%、90%、95% 或更多。例如,如本发明证实,当植物是大豆及生物化学成分是蛋白质时,大豆种子中蛋白质的量可以增加至少大约 30%,如 32.63%(基于干

重),至少大约 45%,如 47.08%(基于干重),至少大约 60%,如 60.63%(基于干重),或者更多。

[0029] 当至少一种生物化学成分的量通过增加所述生物化学成分的量而被改变时,优选甚至希望的是补充(supplement)植物的生长条件,如为生长植物的土壤或其它介质提供一种组合物,所述组合物提供植物生长必需的一或多种营养物质和/或增加植物中至少一种生物化学成分的产生。所述组合物可以是无机的(例如矿物质)、有机的(例如衍生自植物和/或动物)或者其组合。所述组合物可以是天然来源、合成来源或者其组合。这种组合物的一个实例是肥料(例如 Miracle Gro Excel15-5-15)。肥料典型以不同比例提供常量营养元素,如氮、磷、钾、钙、镁和硫。肥料也典型以不同比例提供微量营养元素,如硼、氯、铜、铁、锰、钼和锌。其它营养物质如碳、氢和氧典型由水和二氧化碳提供。如果需要,所述组合物(如肥料)可以是控制释放组合物。在这方面,控制释放组合物的成分可以相同速度或不同速度和/或以相同量或不同量释放。过量的指定生物化学成分可以从植物中释放,其将生物化学成分改变量/水平的 QQS 作为植物正常生长/发育或者生命周期的部分在其环境中表达。

[0030] 植物可以是其中生物化学成分的量改变是希望的任何植物。例如,所述植物可以是单子叶植物、双子叶植物或者真菌。举例的植物包括农业重要植物如谷类作物、工业植物、豆科植物、水果、蔬菜、根植物、草坪草、木质植物、热带植物、坚果、观赏植物、药用植物、及真菌等,更特别是玉米、大豆、小麦、大麦、燕麦、亚麻、kiwicha、干小麦(bulgur)、奎奴亚藜、小米、高粱、甘蔗、马铃薯、甘薯、棉花、稻(如印度和日本产水稻)、黑麦、油菜、含油种子油菜(oilseed rape)、向日葵、烟草、豆类、苜蓿、狗牙根(Bermudagrass)、多年生黑麦草、柳枝稷、高羊茅、草坪草、美洲榆、美洲栗木、栓皮栎树(cork oak tree)、桉树、松树、杨树、橡胶树、香蕉、黑莓、蓝莓、草莓、覆盆子、甜瓜(cantaloupe)、瓜(melon)、黄瓜、茄子、番茄、莴苣、萝卜(radish)、蘑菇、胡萝卜、木薯、洋葱、小扁豆、豌豆、鹰嘴豆、木豆、豇豆、红苜蓿、豆类、利马豆、腰果(kidney bean)、蚕豆、绒毛豆(velvet bean)、宽叶菜豆(teparty bean)、胡椒、西兰花、菠菜、squash、南瓜、芥菜、芥蓝(mustard greens)、印度芥菜(Indian mustard)、苹果、梨、桃、樱桃、李子、葡萄、甘蓝、花椰菜、brussel sprouts、柑橘、橙子、柠檬、酸橙、葡萄柚、蜜橘、clementine、石榴、猕猴桃、starfruit、茴芹、番木瓜、菠萝、咖啡、落花生、棕榈仁、胡桃、花生、杏仁、美洲山核桃(pecans)、栗子、夏威夷果(macadamia nuts)、榛子、向日葵、苦苣、韭葱、甜菜、芜菁、苜蓿、红苜蓿、barrel clover、康乃馨、菊花、兰花、矮牵牛花、玫瑰、人参、大麻、罂粟、非洲槐豆、非洲油豆、tarwi、罗望子、绿豆、Sesban 豆、Lablab 豆、Jack-豆、lupin、及乳草(milkweed)。

[0031] 可以使用本领域已知的任何合适方法在植物中表达 QQS。例如,可以将 QQS 作为转基因导入植物中,使用电穿孔、微粒轰击、农杆菌介导的转化(如实施例 1 例证)以及直接接触原生质体进行。单子叶植物和双子叶植物的转化/转染(以及用于将 DNA 导入植物或真菌中的其它技术)及再生是常规技术。使用的特别方法部分依赖于转化/转染的植物或真菌的类型。例如,由 Kan Wang 编辑、Humana Press, Totowa, New Jersey 出版的 *Agrobacterium Protocols, 2nd ed., Vols. 1 and 2, Methods in Molecular Biology* 中描述了许多方案,其全部内容援引加入本文。这些方案包括浸花转化法及转化叶外植体、子叶外植体和根外植体方法,以及转化 barrel clover、烟草、大麦、玉米、稻(印度和日本产)、黑

麦、高粱、小麦、油菜 (canola)、棉花、印度芥菜、向日葵、紫苜蓿、鹰嘴豆、苜蓿、豌豆、花生、木豆、红苜蓿、大豆、宽叶菜豆、芋头、甘蓝、黄瓜、茄子、莴苣、番茄、胡萝卜、木薯、马铃薯、甘薯、薯蓣、狗牙根 (Bermudagrass)、多年生黑麦草、柳枝稷、高羊茅、草坪草、美洲榆树、栓皮栎 (cork oak)、桉树、松树、杨树、橡胶树、香蕉、柑橘、咖啡、番木瓜、菠萝、甘蔗、美洲栗木、苹果、蓝莓、葡萄、草莓、胡桃、康乃馨、菊花、兰花、矮牵牛花、玫瑰、人参、大麻、罂粟及蘑菇的特定方案。谷类植物的农杆菌介导转化的其它方法由 Shrawat et al., *Plant Biotech. J.* 4(6):575-603 (Nov. 2006) 描述, 其以全部内容援引加入本文。转化豆科植物的其它方法由 Somers et al., *Plant Physiol.* 131(3):892-899 (March 2003) 描述, 其以全部内容援引加入本文。可用于转化稻的方法由 Giri et al., *Biotech. Adv.* 18(8):653-683 (Dec. 2000) 和 Hiei et al., *Plant Mol. Biol.* 35(1-2):205-218 (Sept. 1997) 描述, 其以全部内容援引加入本文。以全部内容援引加入本文的 Vasil et al., *Methods Molec. Biol.* 111:349-358 (1999) 和 Jones et al., *Plant Methods* 1(1):5 (Sept. 5, 2005) 描述了可用于小麦转化的方法。大麦中直接 DNA 摄取的应用在 Lazzeri, *Methods Molec. Biol.* 49:95-106 (1996) 中描述, 其以全部内容援引加入本文。在生物反应器系统中使用暂时浸没以转化草莓的方法在 Hanhineva et al., *BMC Biotech.* 7:11 (2007) 中描述, 其以全部内容援引加入本文。将转基因导入质体如叶绿体、特别是烟草叶绿体中已经由 Daniell et al., *Trends Biotech.* 23(5):238-245 (May 2005) 描述, 其以全部内容援引加入本文。在这方面, Lutz et al., *Plant Physiol.* 145(4):1201-1210 (2007) (特别以其全部内容援引加入本文) 提供了选择载体以在高等植物中转化质体基因组的指导。物种特异性叶绿体载体的体细胞胚发生也用于植物如大豆、胡萝卜和棉花中。可用于转化甜菜的其它方法已经由 Golovko et al., *Tsitol. Genet.* 39(3):30-36 (May-June 2005) 描述, 其以全部内容援引加入本文。

[0032] 编码 QQS 的编码结构域序列 (CDS) 的核苷酸序列可以掺入载体或盒 (在本文统称为载体) 中在植物中表达。已经描述了许多适于稳定转化植物细胞及适于建立转基因植物的表达载体 (见例如 Weissbach et al., *Methods for Plant Molecular Biology*, Academic Press, New York, NY (1989); 及 Gelvin et al., *Plant Molecular Biology Manual*, Kluwer Academic Publishers, Norwell, MA (1990))。来自根癌土壤杆菌 (*Agrobacterium tumefaciens*) 的 Ti 质粒或者二元农杆菌载体 (Bevan, *Nucl. Acids Res.* 12:8711-8721 (1984)) 可用于转化单子叶植物和双子叶植物。非-Ti 载体如病毒载体可用于将 DNA 转移进植物细胞、组织、胚和植物中。非-Ti 载体可以通过使用如下方式导入: 脂质体介导的转化、聚乙二醇 (PEG)-介导的转化、病毒转染、显微注射、真空渗滤、植物原生质体电穿孔、微粒轰击、silicon carbide whiskers 等。见例如 Ammirato et al., *Handbook of Plant Cell Culture - Crop Species*, MacMillan Pub. Co. (1984)、Shimamoto et al., *Nature* 338:274-276 (1989)、Fromm et al., *Bio/Technology* 8:833-839 (1990) 以及 Vasil et al., *Biol. Technology* 8:429-434 (1990) 所述。

[0033] 除了编码序列之外, 植物转化 / 转染载体包含一或多个 5' 和 3' 转录调节序列。转录调节序列可包括启动子、转录起始位点、转录终止位点、聚腺苷酸化信号和 3' 终止子区域 (例如马铃薯 PI-II 终止子区域、章鱼碱合酶 3' 终止子区域或者胭脂碱合酶 3' 终止子区域)。如果存在常规核加工的内含子, 也可以包括一或多个 RNA 加工信号, 如内含子剪接位

点。可以使用任何合适的启动子。在这方面,可以使用 QQS 启动子。或者,可以使用非-QQS 启动子。启动子可以是组成型、合成(例如杂种)、诱导型、发育调节的、环境调节的、激素调节的、化学调节的、细胞特异性或者组织特异性(例如种子特异性)启动子。组成型启动子包括花椰菜花叶病毒(CaMV)35S 启动子、胭脂碱合酶启动子及章鱼碱合酶启动子。环境调节的诱导型启动子包括例如由光诱导的启动子。napin 启动子、菜豆球蛋白启动子和 DC3 启动子是举例的种子特异性启动子,而 dru1 启动子、2A11 启动子和番茄聚半乳糖醛酸酶启动子是举例的果实特异性启动子,PTA29、PTA26 和 PTA13 是举例的花粉特异性启动子。pBAN 启动子是拟南芥中种皮启动子,而 p26、p63 和 p63tr 是来自拟南芥的早期种子启动子(见例如美国专利申请公开号 2009/0031450)。举例的根特异性启动子在美国专利号 5,618,988、5,837,848 和 5,905,186 中描述。其它启动子由植物生长激素、细胞分裂素、赤霉素、甲基茉莉酮酸盐/酯、水杨酸、热、光等诱导。

[0034] 鉴于上述内容,本发明还提供了包含编码 QQS 编码序列的核苷酸序列的载体,所述核苷酸序列与促进所述核苷酸序列在植物中表达的非天然启动子可操纵地连接,其中所述植物是除了拟南芥属之外的植物。所述核苷酸序列优选编码 SEQ ID NO:2 所示氨基酸序列。举例的这种核苷酸序列是 SEQ ID NO:1,但是本领域技术人员意识到由于遗传密码的简并性,许多其它核苷酸序列也可编码 SEQ ID NO:2 所示氨基酸序列。在这方面,本领域技术人员也将意识到在所述核苷酸序列中可以导入一或多个突变,从而使得 QQS 的氨基酸序列改变。如果在 QQS 的氨基酸序列中导入突变,优选所述突变不改变 QQS 的功能或者以一些方式改良 QQS 的功能。“非天然”是指启动子不同于在 WT 拟南芥中促进 QQS 表达的启动子。“非天然”涵盖了使用其它拟南芥启动子,即其它非 QQS 启动子。如上文描述,所述启动子可以是任何合适的启动子,如组成型启动子,例如花椰菜花叶病毒 35S 启动子,合成启动子(如杂种),诱导型启动子,发育特异性启动子,如种子特异性启动子,及合成的启动子,如杂种启动子。在大豆中高活性的启动子如组成型聚泛素启动子和早期胚-特异性热激蛋白 90-样启动子在美国专利申请公开号 2010/0186119 中描述。本文描述的改变植物中至少一种生物化学成分的方法不限于使用包含与非天然启动子可操纵地连接的编码 QQS 编码序列的核苷酸序列的载体,也可以使用包含与 QQS 启动子可操纵地连接的编码 QQS 编码序列的核苷酸序列的载体。

[0035] 在转化/转染(或者将 DNA 导入植物中的其它方法)后,使用掺入载体/盒中的显性选择标记(例如抗生素或除草剂抗性)选择植物。在选择了转化/转染的植物之后,使其生长至成熟。鉴别示出至少一种生物化学成分的量被改变的植物。通过使用 Northern 印迹、RT-PCR、微阵列或者下一代测序分析 mRNA 表达或者通过使用免疫印迹、Western 印迹或者凝胶迁移测定分析蛋白质表达/积聚而证实调节。

[0036] 鉴于上述内容,本发明还提供了转基因植物或其部分。所述转基因植物或其部分包含并表达作为转基因的 QQS,至少一种生物化学成分以与在不表达 QQS 的相应 WT 植物或其部分中存在的量不同的量存在。“其部分”是指植物的任何部分,例如但不限于根、茎、叶、花、雄蕊、花粉、雌蕊、种子等。所述转基因植物可以是如上述任何植物,例如但不限于大豆。

[0037] 本发明还提供了转基因植物的可再生细胞的组织培养物。“组织培养物”是指包含分离的细胞(其可以是相同或不同的)的组合物,或者组成植物的一或多个部分的这种细胞的集合。举例的组织培养物类型包括外植体,愈伤组织,胚,及小植物。“可再生”是指细胞

可以再生为植物,如从中衍生组织培养物的转基因植物。植物组织培养技术为本领域已知(见例如Smith, *Plant Tissue Culture: Techniques and Experiments*, 2nd. ed., Academic Press(2000);及 *Plant Tissue Culture, Development, and Biotechnology*, Trigiano and Gray, eds., CRC Press(2010),所述文献以其全部内容援引加入本文)并且在本文中举例说明(见实施例2)。

[0038] 本发明还提供了生产食品或工业产物的方法。“食品”包括人消费的食品(或者其成分或配料)以及非人动物消耗的饲料(或其成分或配料)。“工业”包括任何及所有非食品产物(或者其成分或配料)。所述方法可包括从如上所述栽培的转基因植物如大豆中或者如上所述从组织培养物中再生的栽培植物中制备食品(或者其成分或配料)或者工业产物(或者其成分或配料)。因此,本发明提供了产生食品或工业产物的改良的方法,其中所述改良包括从栽培的转基因植物中或者从如上述组织培养物中再生的栽培植物中制备食品或者工业产物。

[0039] 例如,大豆可以以其整体使用,但是通常被加工为两种主要产物,即大豆蛋白(粉)和粗制大豆油。这两种产物通常均为特定用途而进一步精制。粗制大豆油可以被分解为甘油、脂肪酸和甾醇。大豆蛋白可以分成大豆粉浓缩物和分离物。从大豆中制成的举例的“食品”包括但不限于咖啡奶精、人造奶油、蛋黄酱、沙拉酱调料、起酥油、面包产品、巧克力涂层、谷物食品、啤酒、水产业饲料、蜜蜂饲料、小牛饲料替代物、鱼饲料、家畜饲料、禽类饲料及宠物饲料。举例的“工业”产物包括但不限于粘合剂、木质复合材料、抗静电制剂、填充化合物、溶剂、消毒剂、杀真菌剂、油墨、颜料、保护性涂层、墙板、抗泡沫剂和橡胶。

[0040] 如果需要,本文所述植物可用于植物育种方法中。例如,植物育种方法可用于在本文所述植物中导入一或多个其它性状,例如较高产量。见例如2004年3月25日公开的美国专利申请公开号2004/0060082中所述方法,其以全部内容援引加入本文。

[0041] 本文所述方法可用于评估植物中其它具有模糊特征的蛋白质(POF)的。希望地,所述POF与QQS共有一些特征,如与同一植物内其它蛋白无序列相似性,或者与其它植物物种如同一种的相关植物物种中的其它蛋白无序列相似性,无已知催化基序,及无已知结构基序。最初,所述POF可以通过将其一级氨基酸序列与数据库如PFAM、TIGRFAM、SMART及Superfamily中其它氨基酸序列对比而鉴别,使用一组同源和/或直系同源多肽的共有序列的统计学模型,如Hidden Markov Model(HMM)(见例如Durbin et al., *Biological Sequence Analysis Probabilistic Models of Proteins and Nucleic Acids*, Cambridge University Press, Cambridge, UK(1988)),发现无匹配(Gollery et al., *Genome Biol.* 7:R57(2006))。通过这种方法在拟南芥中鉴别的举例的POF包括:基因座ID AT1G01110, AT1G01130, AT1G01240, AT1G01400, AT1G01440, AT1G01500, AT1G01550, AT1G01725, AT1G01730, AT1G01810, AT1G01840, AT1G01990, AT1G02070, AT1G02110, AT1G02290, AT1G02320, AT1G02350, AT1G02380, AT1G02405, AT1G02450, AT1G02490, AT1G02540, AT1G02570, AT1G02700, AT1G02710, AT1G02870, AT1G02960, AT1G02965, AT1G02990, AT1G03055, AT1G03080, AT1G03090, AT1G03106, AT1G03170, AT1G03180, AT1G03200, AT1G03240, AT1G03260, AT1G03290, AT1G03320, AT1G03340, AT1G03420, AT1G03600, AT1G03660, AT1G03730, AT1G03780, AT1G03820, AT1G03910, AT1G04000, AT1G04030, AT1G04070, AT1G04200, AT1G04230, AT1G04330, AT1G04650, AT1G04660, AT1G04670, AT1G04750, AT1G04800, AT1G04930, AT1G04985, AT1G05040, AT

1G05060, AT1G05065, AT1G05085, AT1G05090, AT1G05205, AT1G05210, AT1G05220, AT1G05320, AT1G05330, AT1G05340, AT1G05360, AT1G05385, AT1G05420, AT1G05430, AT1G05440, AT1G05450, AT1G05490, AT1G05575, AT1G05720, AT1G05780, AT1G05860, AT1G05894, AT1G06010, AT1G06135, AT1G06225, AT1G06240, AT1G06320, AT1G06420, AT1G06475, AT1G06500, AT1G06510, AT1G06540, AT1G06660, AT1G06770, AT1G06920, AT1G06923, AT1G06930, AT1G06950, AT1G06980, AT1G07020, AT1G07040, AT1G07060, AT1G07090, AT1G07135, AT1G07190, AT1G07290, AT1G07300, AT1G07330, AT1G07473, AT1G07476, AT1G07500, AT1G07680, AT1G07690, AT1G07795, AT1G07860, AT1G07910, AT1G07970, AT1G07985, AT1G07990, AT1G08020, AT1G08030, AT1G08035, AT1G08060, AT1G08180, AT1G08300, AT1G08380, AT1G08480, AT1G08520, AT1G08530, AT1G08580, AT1G09415, AT1G09470, AT1G09483, AT1G09645, AT1G09812, AT1G09950, AT1G09995, AT1G10100, AT1G10140, AT1G10155, AT1G10170, AT1G10180, AT1G10220, AT1G10250, AT1G10380, AT1G10385, AT1G10417, AT1G10420, AT1G10522, AT1G10530, AT1G10620, AT1G10650, AT1G10660, AT1G10690, AT1G10710, AT1G10790, AT1G10800, AT1G10840, AT1G10990, AT1G11070, AT1G11120, AT1G11240, AT1G11320, AT1G11400, AT1G11430, AT1G11440, AT1G11470, AT1G11480, AT1G11520, AT1G11655, AT1G11690, AT1G11850, AT1G11905, AT1G11915, AT1G12020, AT1G12040, AT1G12064, AT1G12080, AT1G12330, AT1G12380, AT1G12450, AT1G12530, AT1G12660, AT1G12670, AT1G12805, AT1G12810, AT1G12830, AT1G12845, AT1G13030, AT1G13220, AT1G13360, AT1G13390, AT1G13605, AT1G13607, AT1G13608, AT1G13609, AT1G13620, AT1G13650, AT1G13670, AT1G13755, AT1G13930, AT1G13990, AT1G14180, AT1G14280, AT1G14345, AT1G14450, AT1G14620, AT1G14630, AT1G14710, AT1G14755, AT1G14990, AT1G15010, AT1G15215, AT1G15230, AT1G15260, AT1G15270, AT1G15280, AT1G15320, AT1G15350, AT1G15385, AT1G15400, AT1G15415, AT1G15590, AT1G15600, AT1G15610, AT1G15620, AT1G15630, AT1G15640, AT1G15757, AT1G15770, AT1G15800, AT1G15825, AT1G15830, AT1G15840, AT1G15900, AT1G15940, AT1G16000, AT1G16020, AT1G16025, AT1G16080, AT1G16170, AT1G16500, AT1G16515, AT1G16630, AT1G16690, AT1G16730, AT1G16770, AT1G16790, AT1G16810, AT1G16840, AT1G16850, AT1G16860, AT1G16910, AT1G16950, AT1G16960, AT1G17030, AT1G17080, AT1G17090, AT1G17140, AT1G17270, AT1G17285, AT1G17300, AT1G17345, AT1G17350, AT1G17360, AT1G17400, AT1G17490, AT1G17510, AT1G17665, AT1G17780, AT1G17870, AT1G17900, AT1G17940, AT1G18000, AT1G18010, AT1G18060, AT1G18190, AT1G18220, AT1G18290, AT1G18380, AT1G18470, AT1G18510, AT1G18620, AT1G18730, AT1G18750, AT1G18810, AT1G18840, AT1G18850, AT1G18950, AT1G19010, AT1G19020, AT1G19030, AT1G19240, AT1G19330, AT1G19360, AT1G19394, AT1G19397, AT1G19400, AT1G19500, AT1G19520, AT1G19530, AT1G19620, AT1G19960, AT1G19980, AT1G19990, AT1G20070, AT1G20100, AT1G20180, AT1G20280, AT1G20290, AT1G20310, AT1G20430, AT1G20460, AT1G20530, AT1G20640, AT1G20690, AT1G20770, AT1G20830, AT1G20890, AT1G20970, AT1G21010, AT1G21020, AT1G21050, AT1G21170, AT1G21323, AT1G21330, AT1G21360, AT1G21370, AT1G21390, AT1G21395, AT1G21475, AT1G21500, AT1G21510, AT1G21520, AT1G21560, AT1G21580, AT1G21600, AT1G21610, AT1G21695, AT1G21740, AT1G21770, AT1G21830, AT1G21840, AT1G21940, AT1G21950, AT1G22010, AT1G22030, AT1G22060, AT1G22110, AT1G22120, AT1G22140, AT1G22230, AT1G22260, AT1G22275, AT1G22335, AT1G22420, AT1G22470, AT1G22590, AT1G22600, AT1G22680, AT1G2

2770, AT1G22790, AT1G22850, AT1G22885, AT1G22890, AT1G22970, AT1G22980, AT1G23040, AT1G23050, AT1G23060, AT1G23110, AT1G23150, AT1G23170, AT1G23230, AT1G23270, AT1G23510, AT1G23530, AT1G23540, AT1G23650, AT1G23830, AT1G23840, AT1G23850, AT1G24050, AT1G24060, AT1G24145, AT1G24160, AT1G24270, AT1G24310, AT1G24370, AT1G24380, AT1G24390, AT1G24460, AT1G24560, AT1G24575, AT1G24600, AT1G24706, AT1G24822, AT1G24851, AT1G24938, AT1G24996, AT1G25025, AT1G25097, AT1G25112, AT1G25170, AT1G25180, AT1G25275, AT1G25400, AT1G25425, AT1G25540, AT1G26110, AT1G26140, AT1G26180, AT1G26210, AT1G26290, AT1G26350, AT1G26600, AT1G26650, AT1G26665, AT1G26710, AT1G26720, AT1G26750, AT1G27020, AT1G27030, AT1G27090, AT1G27300, AT1G27385, AT1G27435, AT1G27510, AT1G27550, AT1G27610, AT1G27640, AT1G27670, AT1G27690, AT1G27695, AT1G27710, AT1G27790, AT1G27850, AT1G27990, AT1G28060, AT1G28080, AT1G28100, AT1G28135, AT1G28140, AT1G28150, AT1G28190, AT1G28240, AT1G28250, AT1G28260, AT1G28327, AT1G28375, AT1G28395, AT1G28400, AT1G28530, AT1G28540, AT1G28560, AT1G28630, AT1G28760, AT1G29010, AT1G29170, AT1G29179, AT1G29195, AT1G29270, AT1G29290, AT1G29300, AT1G29355, AT1G29480, AT1G29530, AT1G29540, AT1G29560, AT1G29580, AT1G29610, AT1G29620, AT1G29820, AT1G29830, AT1G29970, AT1G29980, AT1G30050, AT1G30190, AT1G30250, AT1G30260, AT1G30475, AT1G30515, AT1G30757, AT1G30795, AT1G30814, AT1G30835, AT1G30845, AT1G30850, AT1G30880, AT1G31050, AT1G31060, AT1G31130, AT1G31150, AT1G31175, AT1G31200, AT1G31250, AT1G31270, AT1G31335, AT1G31460, AT1G31520, AT1G31580, AT1G31620, AT1G31750, AT1G31772, AT1G31835, AT1G31870, AT1G31940, AT1G31960, AT1G31990, AT1G32000, AT1G32010, AT1G32040, AT1G32260, AT1G32290, AT1G32310, AT1G32337, AT1G32370, AT1G32390, AT1G32460, AT1G32570, AT1G32583, AT1G32610, AT1G32630, AT1G32650, AT1G32670, AT1G32680, AT1G32690, AT1G32720, AT1G32810, AT1G32920, AT1G32928, AT1G32975, AT1G33055, AT1G33135, AT1G33490, AT1G33500, AT1G33607, AT1G33640, AT1G33700, AT1G33710, AT1G33810, AT1G33820, AT1G33850, AT1G33860, AT1G34000, AT1G34010, AT1G34047, AT1G34095, AT1G34245, AT1G34280, AT1G34315, AT1G34350, AT1G34400, AT1G34440, AT1G34490, AT1G34520, AT1G34550, AT1G34570, AT1G34590, AT1G34630, AT1G34640, AT1G34730, AT1G34770, AT1G34910, AT1G35030, AT1G35040, AT1G35080, AT1G35100, AT1G35183, AT1G35230, AT1G35320, AT1G35340, AT1G35375, AT1G35430, AT1G35435, AT1G35500, AT1G35513, AT1G35570, AT1G35614, AT1G35617, AT1G35640, AT1G35663, AT1G35780, AT1G35820, AT1G35880, AT1G35890, AT1G35900, AT1G36020, AT1G36100, AT1G36230, AT1G36320, AT1G36380, AT1G36395, AT1G36640, AT1G36670, AT1G36675, AT1G36745, AT1G36756, AT1G36763, AT1G36925, AT1G36940, AT1G36960, AT1G36970, AT1G36990, AT1G37000, AT1G37010, AT1G37015, AT1G37037, AT1G37045, AT1G38380, AT1G38630, AT1G38790, AT1G38950, AT1G39350, AT1G40080, AT1G40087, AT1G40115, AT1G40125, AT1G40129, AT1G40133, AT1G40230, AT1G41650, AT1G41750, AT1G41770, AT1G41810, AT1G41820, AT1G41855, AT1G41870, AT1G41900, AT1G41920, AT1G42080, AT1G42190, AT1G42367, AT1G42393, AT1G42430, AT1G42515, AT1G42550, AT1G42580, AT1G42630, AT1G42700, AT1G42710, AT1G42740, AT1G42960, AT1G43205, AT1G43230, AT1G43310, AT1G43320, AT1G43330, AT1G43415, AT1G43570, AT1G43580, AT1G43590, AT1G43660, AT1G43720, AT1G43730, AT1G43777, AT1G43790, AT1G43810, AT1G43850, AT1G43920, AT1G4394

0, AT1G43970, AT1G44000, AT1G44010, AT1G44085, AT1G44222, AT1G44414, AT1G44740, AT1G44770, AT1G44780, AT1G44850, AT1G44875, AT1G44920, AT1G44930, AT1G44960, AT1G44990, AT1G45150, AT1G45165, AT1G45170, AT1G45230, AT1G45233, AT1G45248, AT1G45403, AT1G45688, AT1G46336, AT1G47200, AT1G47280, AT1G47310, AT1G47317, AT1G47395, AT1G47400, AT1G47410, AT1G47420, AT1G47485, AT1G47495, AT1G47640, AT1G47660, AT1G47680, AT1G47690, AT1G47700, AT1G47770, AT1G47783, AT1G47813, AT1G47820, AT1G47940, AT1G47970, AT1G48145, AT1G48170, AT1G48200, AT1G48250, AT1G48280, AT1G48290, AT1G48325, AT1G48330, AT1G48360, AT1G48380, AT1G48440, AT1G48460, AT1G48510, AT1G48530, AT1G48580, AT1G48720, AT1G48730, AT1G48780, AT1G48840, AT1G49000, AT1G49005, AT1G49110, AT1G49140, AT1G49150, AT1G49260, AT1G49290, AT1G49310, AT1G49330, AT1G49410, AT1G49490, AT1G49500, AT1G49510, AT1G49680, AT1G49700, AT1G49715, AT1G49800, AT1G49840, AT1G49870, AT1G49930, AT1G49940, AT1G49975, AT1G50020, AT1G50080, AT1G50150, AT1G50220, AT1G50290, AT1G50350, AT1G50530, AT1G50660, AT1G50710, AT1G50730, AT1G50800, AT1G50910, AT1G50930, AT1G51000, AT1G51010, AT1G51030, AT1G51080, AT1G51100, AT1G51130, AT1G51355, AT1G51400, AT1G51405, AT1G51430, AT1G51840, AT1G51915, AT1G51920, AT1G51970, AT1G52080, AT1G52087, AT1G52090, AT1G52140, AT1G52155, AT1G52220, AT1G52270, AT1G52320, AT1G52390, AT1G52410, AT1G52430, AT1G52440, AT1G52450, AT1G52550, AT1G52565, AT1G52615, AT1G52680, AT1G52720, AT1G52780, AT1G52825, AT1G52827, AT1G52840, AT1G52855, AT1G52905, AT1G53035, AT1G53040, AT1G53180, AT1G53250, AT1G53260, AT1G53265, AT1G53285, AT1G53380, AT1G53400, AT1G53450, AT1G53460, AT1G53480, AT1G53490, AT1G53560, AT1G53610, AT1G53620, AT1G53625, AT1G53640, AT1G53645, AT1G53760, AT1G53770, AT1G53785, AT1G53800, AT1G53935, AT1G53970, AT1G54110, AT1G54120, AT1G54180, AT1G54200, AT1G54215, AT1G54217, AT1G54300, AT1G54420, AT1G54445, AT1G54470, AT1G54575, AT1G54640, AT1G54680, AT1G54700, AT1G54720, AT1G54730, AT1G54740, AT1G54770, AT1G54780, AT1G54840, AT1G54860, AT1G54880, AT1G54920, AT1G54923, AT1G54926, AT1G54950, AT1G54955, AT1G54970, AT1G55080, AT1G55160, AT1G55220, AT1G55250, AT1G55330, AT1G55365, AT1G55400, AT1G55475, AT1G55535, AT1G55540, AT1G55545, AT1G55675, AT1G55710, AT1G55800, AT1G55928, AT1G55990, AT1G56020, AT1G56060, AT1G56085, AT1G56100, AT1G56180, AT1G56200, AT1G56260, AT1G56270, AT1G56320, AT1G56415, AT1G56420, AT1G56530, AT1G56553, AT1G56555, AT1G56660, AT1G57540, AT1G57565, AT1G57670, AT1G57680, AT1G57760, AT1G58055, AT1G58120, AT1G58150, AT1G58225, AT1G58235, AT1G58242, AT1G58250, AT1G58330, AT1G58420, AT1G58460, AT1G58520, AT1G58766, AT1G59077, AT1G59510, AT1G59520, AT1G59535, AT1G59590, AT1G59600, AT1G59722, AT1G59835, AT1G59840, AT1G59865, AT1G59885, AT1G59920, AT1G59930, AT1G60000, AT1G60010, AT1G60060, AT1G60240, AT1G60250, AT1G60380, AT1G60460, AT1G60560, AT1G60610, AT1G60640, AT1G60720, AT1G60870, AT1G60983, AT1G60987, AT1G61000, AT1G61030, AT1G61080, AT1G61090, AT1G61095, AT1G61097, AT1G61100, AT1G61170, AT1G61200, AT1G61255, AT1G61340, AT1G61410, AT1G61450, AT1G61688, AT1G61780, AT1G61900, AT1G61920, AT1G62000, AT1G62045, AT1G62060, AT1G62070, AT1G62080, AT1G62190, AT1G62210, AT1G62220, AT1G62225, AT1G62240, AT1G62250, AT1G62440, AT1G62480, AT1G62690, AT1G62780, AT1G62855, AT1G62870, AT1G62890, A

T1G62935, AT1G63055, AT1G63060, AT1G63105, AT1G63240, AT1G63245, AT1G63300, AT1G63310, AT1G63522, AT1G63530, AT1G63535, AT1G63540, AT1G63610, AT1G63670, AT1G63720, AT1G63960, AT1G64050, AT1G64080, AT1G64107, AT1G64140, AT1G64180, AT1G64295, AT1G64320, AT1G64330, AT1G64340, AT1G64355, AT1G64360, AT1G64370, AT1G64385, AT1G64405, AT1G64490, AT1G64560, AT1G64680, AT1G64690, AT1G64700, AT1G64800, AT1G64870, AT1G64990, AT1G65010, AT1G65090, AT1G65110, AT1G65120, AT1G65130, AT1G65200, AT1G65230, AT1G65270, AT1G65295, AT1G65342, AT1G65352, AT1G65470, AT1G65490, AT1G65500, AT1G65510, AT1G65710, AT1G65720, AT1G65845, AT1G66070, AT1G66080, AT1G66145, AT1G66190, AT1G66235, AT1G66245, AT1G66480, AT1G66790, AT1G66820, AT1G66840, AT1G66890, AT1G66940, AT1G67025, AT1G67035, AT1G67040, AT1G67050, AT1G67060, AT1G67080, AT1G67170, AT1G67195, AT1G67230, AT1G67350, AT1G67540, AT1G67635, AT1G67670, AT1G67700, AT1G67775, AT1G67790, AT1G67855, AT1G67860, AT1G67865, AT1G67870, AT1G67910, AT1G67920, AT1G67930, AT1G67950, AT1G68250, AT1G68330, AT1G68350, AT1G68430, AT1G68440, AT1G68490, AT1G68500, AT1G68680, AT1G68700, AT1G68725, AT1G68765, AT1G68790, AT1G68795, AT1G68845, AT1G68870, AT1G68875, AT1G68905, AT1G68907, AT1G68910, AT1G68935, AT1G68945, AT1G69050, AT1G69160, AT1G69170, AT1G69230, AT1G69280, AT1G69320, AT1G69380, AT1G69390, AT1G69430, AT1G69470, AT1G69760, AT1G69825, AT1G69935, AT1G69970, AT1G69980, AT1G70100, AT1G70160, AT1G70200, AT1G70220, AT1G70350, AT1G70470, AT1G70505, AT1G70620, AT1G70760, AT1G70770, AT1G70780, AT1G70895, AT1G70900, AT1G70985, AT1G70990, AT1G71015, AT1G71080, AT1G71110, AT1G71190, AT1G71235, AT1G71240, AT1G71310, AT1G71430, AT1G71470, AT1G71730, AT1G71740, AT1G71760, AT1G71780, AT1G71865, AT1G71910, AT1G71940, AT1G72020, AT1G72080, AT1G72240, AT1G72380, AT1G72390, AT1G72410, AT1G72420, AT1G72430, AT1G72490, AT1G72530, AT1G72580, AT1G72600, AT1G72645, AT1G72690, AT1G72720, AT1G72790, AT1G73060, AT1G73090, AT1G73120, AT1G73130, AT1G73165, AT1G73177, AT1G73240, AT1G73350, AT1G73470, AT1G73510, AT1G73603, AT1G73607, AT1G73770, AT1G73790, AT1G73840, AT1G73885, AT1G73940, AT1G73965, AT1G73970, AT1G74045, AT1G74055, AT1G74160, AT1G74220, AT1G74530, AT1G74860, AT1G74880, AT1G75060, AT1G75110, AT1G75150, AT1G75160, AT1G75180, AT1G75190, AT1G75260, AT1G75310, AT1G75360, AT1G75550, AT1G75730, AT1G75770, AT1G75810, AT1G75860, AT1G75870, AT1G76070, AT1G76185, AT1G76200, AT1G76230, AT1G76250, AT1G76340, AT1G76405, AT1G76450, AT1G76480, AT1G76600, AT1G76610, AT1G76660, AT1G76740, AT1G76780, AT1G76820, AT1G76840, AT1G76850, AT1G76910, AT1G76955, AT1G76960, AT1G76965, AT1G76980, AT1G77150, AT1G77270, AT1G77310, AT1G77350, AT1G77400, AT1G77500, AT1G77540, AT1G77655, AT1G77765, AT1G77855, AT1G77885, AT1G77890, AT1G77910, AT1G77960, AT1G78030, AT1G78070, AT1G78110, AT1G78150, AT1G78170, AT1G78650, AT1G78790, AT1G78810, AT1G78815, AT1G78880, AT1G78890, AT1G78895, AT1G78995, AT1G79020, AT1G79060, AT1G79070, AT1G79090, AT1G79100, AT1G79110, AT1G79160, AT1G79170, AT1G79200, AT1G79260, AT1G79390, AT1G79420, AT1G79430, AT1G79660, AT1G79830, AT1G79915, AT1G79970, AT1G79975, AT1G80000, AT1G80110, AT1G80180, AT1G80200, AT1G80210, AT1G80240, AT1G80245, AT1G80310, AT1G80540, AT1G80610, AT1G80700, AT1G80810, AT1G80860, AT1G80865, AT1G80890, AT1G80910, AT1G80940, AT1G

80980, AT2G01031, AT2G01060, AT2G01100, AT2G01120, AT2G01175, AT2G01200, AT2G01300, AT2G01310, AT2G01340, AT2G01400, AT2G01505, AT2G01580, AT2G01590, AT2G01620, AT2G01640, AT2G01650, AT2G01670, AT2G01755, AT2G01800, AT2G01870, AT2G01913, AT2G01940, AT2G01960, AT2G01990, AT2G02070, AT2G02280, AT2G02350, AT2G02370, AT2G02440, AT2G02490, AT2G02510, AT2G02515, AT2G02520, AT2G02795, AT2G02835, AT2G02840, AT2G02880, AT2G02910, AT2G02950, AT2G03010, AT2G03070, AT2G03150, AT2G03180, AT2G03310, AT2G03320, AT2G03420, AT2G03440, AT2G03540, AT2G03570, AT2G03580, AT2G03630, AT2G03680, AT2G03810, AT2G03830, AT2G03932, AT2G03937, AT2G04000, AT2G04025, AT2G04034, AT2G04039, AT2G04045, AT2G04046, AT2G04063, AT2G04135, AT2G04235, AT2G04280, AT2G04305, AT2G04320, AT2G04340, AT2G04360, AT2G04370, AT2G04380, AT2G04410, AT2G04460, AT2G04480, AT2G04495, AT2G04515, AT2G04600, AT2G04675, AT2G04790, AT2G04795, AT2G04800, AT2G04870, AT2G04925, AT2G05000, AT2G05030, AT2G05117, AT2G05120, AT2G05185, AT2G05270, AT2G05290, AT2G05310, AT2G05350, AT2G05360, AT2G05370, AT2G05500, AT2G05564, AT2G05620, AT2G05645, AT2G05647, AT2G05752, AT2G05915, AT2G05950, AT2G06005, AT2G06010, AT2G06040, AT2G06095, AT2G06140, AT2G06166, AT2G06200, AT2G06230, AT2G06390, AT2G06420, AT2G06480, AT2G06555, AT2G06570, AT2G06620, AT2G06630, AT2G06645, AT2G06750, AT2G06775, AT2G06820, AT2G06906, AT2G06908, AT2G06914, AT2G07000, AT2G07190, AT2G07215, AT2G07280, AT2G07290, AT2G07310, AT2G07440, AT2G07505, AT2G07520, AT2G07669, AT2G07672, AT2G07673, AT2G07674, AT2G07676, AT2G07678, AT2G07679, AT2G07691, AT2G07692, AT2G07701, AT2G07702, AT2G07705, AT2G07706, AT2G07708, AT2G07710, AT2G07713, AT2G07714, AT2G07719, AT2G07721, AT2G07722, AT2G07724, AT2G07728, AT2G07738, AT2G07760, AT2G07772, AT2G07773, AT2G07774, AT2G07775, AT2G07776, AT2G07777, AT2G07779, AT2G07787, AT2G07795, AT2G07880, AT2G07981, AT2G08986, AT2G09388, AT2G09840, AT2G09865, AT2G09900, AT2G10020, AT2G10070, AT2G10090, AT2G10105, AT2G10110, AT2G10175, AT2G10285, AT2G10340, AT2G10360, AT2G10380, AT2G10390, AT2G10470, AT2G10550, AT2G10555, AT2G10560, AT2G10602, AT2G10608, AT2G10850, AT2G10870, AT2G10920, AT2G10930, AT2G10965, AT2G10975, AT2G10980, AT2G11005, AT2G11015, AT2G11090, AT2G11135, AT2G11370, AT2G11405, AT2G11462, AT2G11570, AT2G11620, AT2G11626, AT2G11775, AT2G11910, AT2G12110, AT2G12120, AT2G12130, AT2G12170, AT2G12290, AT2G12320, AT2G12400, AT2G12405, AT2G12465, AT2G12475, AT2G12505, AT2G12610, AT2G12685, AT2G12700, AT2G12875, AT2G12905, AT2G12935, AT2G12945, AT2G13125, AT2G13126, AT2G13270, AT2G13320, AT2G13430, AT2G13450, AT2G13500, AT2G13510, AT2G13550, AT2G13650, AT2G13660, AT2G13690, AT2G13730, AT2G13760, AT2G13770, AT2G13865, AT2G13975, AT2G14000, AT2G14020, AT2G14045, AT2G14095, AT2G14240, AT2G14247, AT2G14340, AT2G14390, AT2G14460, AT2G14590, AT2G14600, AT2G14635, AT2G14680, AT2G14700, AT2G14730, AT2G14760, AT2G14774, AT2G14800, AT2G14810, AT2G14850, AT2G14890, AT2G14910, AT2G14935, AT2G15000, AT2G15020, AT2G15185, AT2G15290, AT2G15327, AT2G15340, AT2G15345, AT2G15420, AT2G15500, AT2G15520, AT2G15535, AT2G15550, AT2G15600, AT2G15670, AT2G15800, AT2G15815, AT2G15830, AT2G15860, AT2G15880, AT2G15890, AT2G15930, AT2G15960, AT2G16015, AT2G16020, AT2G16070, AT2G16170, AT2G16190, AT2G16200, AT2G16270, AT2G16340, AT2G16365, AT2G163

85, AT2G16410, AT2G16485, AT2G16575, AT2G16586, AT2G16595, AT2G16630, AT2G16676, AT2G16820, AT2G17110, AT2G17160, AT2G17240, AT2G17300, AT2G17320, AT2G17340, AT2G17350, AT2G17442, AT2G17540, AT2G17550, AT2G17695, AT2G17710, AT2G17723, AT2G17780, AT2G17785, AT2G17787, AT2G17960, AT2G17972, AT2G17990, AT2G18070, AT2G18200, AT2G18210, AT2G18240, AT2G18270, AT2G18410, AT2G18440, AT2G18610, AT2G18680, AT2G18690, AT2G18830, AT2G18870, AT2G18876, AT2G18910, AT2G18920, AT2G18930, AT2G18970, AT2G19000, AT2G19090, AT2G19180, AT2G19200, AT2G19220, AT2G19270, AT2G19290, AT2G19300, AT2G19320, AT2G19340, AT2G19390, AT2G19420, AT2G19460, AT2G19530, AT2G19700, AT2G19802, AT2G19850, AT2G19893, AT2G19950, AT2G20080, AT2G20142, AT2G20150, AT2G20208, AT2G20230, AT2G20240, AT2G20250, AT2G20310, AT2G20390, AT2G20410, AT2G20463, AT2G20480, AT2G20495, AT2G20500, AT2G20515, AT2G20585, AT2G20590, AT2G20595, AT2G20616, AT2G20620, AT2G20625, AT2G20700, AT2G20740, AT2G20760, AT2G20820, AT2G20825, AT2G20835, AT2G20870, AT2G20875, AT2G20890, AT2G20920, AT2G20970, AT2G20980, AT2G21080, AT2G21180, AT2G21185, AT2G21195, AT2G21237, AT2G21290, AT2G21385, AT2G21465, AT2G21560, AT2G21640, AT2G21660, AT2G21720, AT2G21725, AT2G21780, AT2G21800, AT2G21820, AT2G21870, AT2G21960, AT2G21970, AT2G21980, AT2G22000, AT2G22080, AT2G22121, AT2G22122, AT2G22140, AT2G22270, AT2G22320, AT2G22340, AT2G22470, AT2G22510, AT2G22520, AT2G22560, AT2G22790, AT2G22795, AT2G22805, AT2G22807, AT2G22820, AT2G22840, AT2G22890, AT2G22905, AT2G22940, AT2G22941, AT2G23040, AT2G23090, AT2G23093, AT2G23110, AT2G23120, AT2G23130, AT2G23270, AT2G23370, AT2G23390, AT2G23440, AT2G23490, AT2G23530, AT2G23670, AT2G23690, AT2G23755, AT2G23920, AT2G23985, AT2G24100, AT2G24285, AT2G24310, AT2G24330, AT2G24340, AT2G24410, AT2G24440, AT2G24460, AT2G24550, AT2G24617, AT2G24625, AT2G24762, AT2G24780, AT2G24910, AT2G24945, AT2G24960, AT2G24970, AT2G25185, AT2G25250, AT2G25260, AT2G25270, AT2G25510, AT2G25565, AT2G25605, AT2G25625, AT2G25670, AT2G25680, AT2G25685, AT2G25720, AT2G25735, AT2G25920, AT2G25930, AT2G25990, AT2G26110, AT2G26120, AT2G26340, AT2G26520, AT2G26770, AT2G26810, AT2G26840, AT2G26880, AT2G27090, AT2G27100, AT2G27180, AT2G27250, AT2G27280, AT2G27285, AT2G27315, AT2G27380, AT2G27385, AT2G27390, AT2G27402, AT2G27535, AT2G27540, AT2G27630, AT2G27650, AT2G27730, AT2G27775, AT2G27830, AT2G27840, AT2G27950, AT2G28020, AT2G28130, AT2G28230, AT2G28240, AT2G28330, AT2G28410, AT2G28430, AT2G28540, AT2G28570, AT2G28605, AT2G28625, AT2G28725, AT2G28755, AT2G28780, AT2G28870, AT2G28910, AT2G29045, AT2G29180, AT2G29620, AT2G29790, AT2G29880, AT2G29920, AT2G29995, AT2G30115, AT2G30120, AT2G30230, AT2G30280, AT2G30350, AT2G30370, AT2G30380, AT2G30395, AT2G30430, AT2G30480, AT2G30505, AT2G30560, AT2G30680, AT2G30700, AT2G30760, AT2G30820, AT2G30925, AT2G30930, AT2G30942, AT2G30960, AT2G30985, AT2G31035, AT2G31040, AT2G31081, AT2G31082, AT2G31083, AT2G31085, AT2G31090, AT2G31120, AT2G31130, AT2G31150, AT2G31160, AT2G31270, AT2G31345, AT2G31410, AT2G31480, AT2G31490, AT2G31590, AT2G31600, AT2G31700, AT2G31710, AT2G31751, AT2G31850, AT2G31930, AT2G31945, AT2G32130, AT2G32190, AT2G32200, AT2G32210, AT2G32235, AT2G32240, AT2G32275, AT2G32380, AT2G32760, AT2G32840, AT2G32890, AT2G32970, AT2G32980, AT2G33180, AT2G33233, AT2G33250,

AT2G33390, AT2G33400, AT2G33435, AT2G33470, AT2G33490, AT2G33520, AT2G33585, AT2G33690, AT2G33720, AT2G33793, AT2G33850, AT2G33855, AT2G34010, AT2G34100, AT2G34110, AT2G34120, AT2G34123, AT2G34150, AT2G34185, AT2G34220, AT2G34230, AT2G34240, AT2G34270, AT2G34310, AT2G34315, AT2G34330, AT2G34510, AT2G34530, AT2G34580, AT2G34585, AT2G34640, AT2G34655, AT2G34670, AT2G34690, AT2G34730, AT2G34780, AT2G34800, AT2G34870, AT2G34910, AT2G35070, AT2G35075, AT2G35080, AT2G35090, AT2G35110, AT2G35200, AT2G35215, AT2G35230, AT2G35260, AT2G35290, AT2G35470, AT2G35480, AT2G35585, AT2G35612, AT2G35670, AT2G35710, AT2G35733, AT2G35736, AT2G35750, AT2G35790, AT2G35810, AT2G35820, AT2G35830, AT2G35850, AT2G35870, AT2G35900, AT2G35950, AT2G36030, AT2G36040, AT2G36145, AT2G36220, AT2G36255, AT2G36295, AT2G36400, AT2G36420, AT2G36440, AT2G36485, AT2G36550, AT2G36695, AT2G36724, AT2G36835, AT2G36885, AT2G36895, AT2G36920, AT2G36940, AT2G37035, AT2G37070, AT2G37080, AT2G37100, AT2G37195, AT2G37300, AT2G37370, AT2G37380, AT2G37530, AT2G37610, AT2G37680, AT2G37750, AT2G37860, AT2G37910, AT2G37920, AT2G37975, AT2G38090, AT2G38140, AT2G38160, AT2G38220, AT2G38350, AT2G38430, AT2G38440, AT2G38465, AT2G38570, AT2G38580, AT2G38690, AT2G38695, AT2G38790, AT2G38823, AT2G38890, AT2G39000, AT2G39160, AT2G39170, AT2G39200, AT2G39300, AT2G39370, AT2G39500, AT2G39520, AT2G39560, AT2G39680, AT2G39855, AT2G39870, AT2G39950, AT2G40020, AT2G40060, AT2G40070, AT2G40085, AT2G40095, AT2G40113, AT2G40316, AT2G40390, AT2G40410, AT2G40475, AT2G40530, AT2G40550, AT2G40630, AT2G40680, AT2G40765, AT2G40955, AT2G41150, AT2G41230, AT2G41260, AT2G41280, AT2G41350, AT2G41390, AT2G41400, AT2G41420, AT2G41440, AT2G41570, AT2G41610, AT2G41650, AT2G41730, AT2G41760, AT2G41770, AT2G41780, AT2G41800, AT2G41810, AT2G41905, AT2G41945, AT2G41960, AT2G41990, AT2G42040, AT2G42050, AT2G42130, AT2G42180, AT2G42190, AT2G42260, AT2G42280, AT2G42310, AT2G42320, AT2G42340, AT2G42370, AT2G42395, AT2G42540, AT2G42610, AT2G42640, AT2G42760, AT2G42840, AT2G42860, AT2G42900, AT2G42950, AT2G42955, AT2G42975, AT2G43110, AT2G43250, AT2G43390, AT2G43450, AT2G43540, AT2G43630, AT2G43780, AT2G43795, AT2G43945, AT2G43950, AT2G43990, AT2G44010, AT2G44080, AT2G44195, AT2G44200, AT2G44280, AT2G44420, AT2G44510, AT2G44600, AT2G44640, AT2G44735, AT2G44740, AT2G44760, AT2G44820, AT2G44850, AT2G45000, AT2G45060, AT2G45250, AT2G45260, AT2G45380, AT2G45403, AT2G45450, AT2G45480, AT2G45520, AT2G45690, AT2G45780, AT2G45860, AT2G45900, AT2G45930, AT2G45980, AT2G46000, AT2G46060, AT2G46080, AT2G46180, AT2G46200, AT2G46250, AT2G46360, AT2G46375, AT2G46380, AT2G46390, AT2G46455, AT2G46490, AT2G46540, AT2G46550, AT2G46640, AT2G46735, AT2G46820, AT2G46830, AT2G46915, AT2G46940, AT2G46980, AT2G47010, AT2G47020, AT2G47115, AT2G47200, AT2G47360, AT2G47480, AT2G47485, AT2G47530, AT2G47660, AT2G47690, AT2G47720, AT2G47840, AT2G47910, AT2G47930, AT2G47950, AT2G48040, AT2G48050, AT2G48060, AT2G48070, AT2G48075, AT2G48090, AT2G48120, AT3G01060, AT3G01130, AT3G01160, AT3G01170, AT3G01230, AT3G01240, AT3G01250, AT3G01323, AT3G01325, AT3G01345, AT3G01430, AT3G01435, AT3G01513, AT3G01516, AT3G01670, AT3G01680, AT3G01700, AT3G01710, AT3G01720, AT3G01730, AT3G01740, AT3G01810, AT3G01860, AT3G01940, AT3G01950, AT3G01960, AT3G02120, AT3G02125, AT3G02170, AT3

G02180, AT3G02220, AT3G02240, AT3G02370, AT3G02390, AT3G02420, AT3G02500, AT3G02555, AT3G02560, AT3G02640, AT3G02670, AT3G02680, AT3G02790, AT3G02860, AT3G02900, AT3G02930, AT3G03020, AT3G03070, AT3G03130, AT3G03150, AT3G03160, AT3G03170, AT3G03210, AT3G03420, AT3G03460, AT3G03560, AT3G03570, AT3G03770, AT3G03773, AT3G03870, AT3G03930, AT3G04020, AT3G04040, AT3G04160, AT3G04310, AT3G04510, AT3G04550, AT3G04560, AT3G04640, AT3G04740, AT3G04903, AT3G04943, AT3G04945, AT3G04960, AT3G04990, AT3G05010, AT3G05020, AT3G05080, AT3G05110, AT3G05130, AT3G05220, AT3G05320, AT3G05330, AT3G05410, AT3G05460, AT3G05550, AT3G05570, AT3G05725, AT3G05727, AT3G05730, AT3G05830, AT3G05900, AT3G05935, AT3G05937, AT3G05980, AT3G06020, AT3G06070, AT3G06090, AT3G06145, AT3G06180, AT3G06360, AT3G06435, AT3G06545, AT3G06547, AT3G06600, AT3G06610, AT3G06670, AT3G06710, AT3G06750, AT3G06780, AT3G06790, AT3G06840, AT3G06870, AT3G06890, AT3G06895, AT3G06960, AT3G07005, AT3G07150, AT3G07180, AT3G07195, AT3G07210, AT3G07425, AT3G07440, AT3G07510, AT3G07560, AT3G07568, AT3G07580, AT3G07640, AT3G07710, AT3G07730, AT3G07790, AT3G07910, AT3G07950, AT3G08030, AT3G08490, AT3G08550, AT3G08610, AT3G08630, AT3G08640, AT3G08650, AT3G08670, AT3G08780, AT3G08880, AT3G08955, AT3G09000, AT3G09032, AT3G09050, AT3G09085, AT3G09130, AT3G09162, AT3G09180, AT3G09280, AT3G09430, AT3G09450, AT3G09730, AT3G09750, AT3G09770, AT3G09860, AT3G09922, AT3G09950, AT3G10020, AT3G10116, AT3G10120, AT3G10195, AT3G10525, AT3G10572, AT3G10650, AT3G10810, AT3G10830, AT3G10880, AT3G10930, AT3G10980, AT3G11030, AT3G11060, AT3G11160, AT3G11300, AT3G11310, AT3G11325, AT3G11405, AT3G11560, AT3G11590, AT3G11600, AT3G11640, AT3G11670, AT3G11690, AT3G11745, AT3G11760, AT3G11800, AT3G11810, AT3G11860, AT3G11880, AT3G12190, AT3G12210, AT3G12320, AT3G12345, AT3G12510, AT3G12650, AT3G12840, AT3G12870, AT3G12910, AT3G12920, AT3G12955, AT3G12960, AT3G12970, AT3G12977, AT3G13130, AT3G13175, AT3G13227, AT3G13240, AT3G13275, AT3G13360, AT3G13370, AT3G13403, AT3G13410, AT3G13420, AT3G13435, AT3G13460, AT3G13480, AT3G13500, AT3G13520, AT3G13630, AT3G13674, AT3G13677, AT3G13780, AT3G13845, AT3G13857, AT3G13910, AT3G13950, AT3G13960, AT3G13980, AT3G14060, AT3G14190, AT3G14280, AT3G14340, AT3G14395, AT3G14430, AT3G14480, AT3G14560, AT3G14595, AT3G14670, AT3G14750, AT3G14760, AT3G14780, AT3G14830, AT3G14840, AT3G14870, AT3G14880, AT3G14900, AT3G14910, AT3G14920, AT3G15000, AT3G15095, AT3G15110, AT3G15115, AT3G15230, AT3G15240, AT3G15250, AT3G15280, AT3G15310, AT3G15340, AT3G15351, AT3G15357, AT3G15358, AT3G15395, AT3G15400, AT3G15420, AT3G15440, AT3G15550, AT3G15560, AT3G15630, AT3G15750, AT3G15760, AT3G15770, AT3G15780, AT3G15820, AT3G15830, AT3G15840, AT3G15860, AT3G15900, AT3G15910, AT3G15950, AT3G16000, AT3G16040, AT3G16070, AT3G16200, AT3G16220, AT3G16330, AT3G16660, AT3G16670, AT3G16750, AT3G16895, AT3G16930, AT3G17120, AT3G17155, AT3G17160, AT3G17190, AT3G17350, AT3G17460, AT3G17580, AT3G17780, AT3G17890, AT3G17900, AT3G17930, AT3G17950, AT3G18050, AT3G18240, AT3G18250, AT3G18300, AT3G18310, AT3G18350, AT3G18410, AT3G18485, AT3G18510, AT3G18540, AT3G18560, AT3G18700, AT3G18770, AT3G18800, AT3G18940, AT3G19020, AT3G19030, AT3G19055, AT3G19120, AT3G19180, AT3G19200, AT3G19220, AT3G19250, AT3G19330, AT3G19340, AT3G19530, AT3G19

540, AT3G19550, AT3G19650, AT3G19660, AT3G19750, AT3G19790, AT3G19800, AT3G19900, AT3G19920, AT3G20070, AT3G20155, AT3G20340, AT3G20350, AT3G20362, AT3G20430, AT3G20450, AT3G20490, AT3G20555, AT3G20557, AT3G20680, AT3G20720, AT3G20760, AT3G20850, AT3G20865, AT3G20900, AT3G20920, AT3G20980, AT3G21000, AT3G21055, AT3G21080, AT3G21260, AT3G21290, AT3G21320, AT3G21400, AT3G21465, AT3G21570, AT3G21680, AT3G21710, AT3G21865, AT3G22070, AT3G22090, AT3G22210, AT3G22231, AT3G22235, AT3G22240, AT3G22270, AT3G22380, AT3G22415, AT3G22430, AT3G22510, AT3G22680, AT3G22790, AT3G22820, AT3G22840, AT3G22942, AT3G23040, AT3G23165, AT3G23167, AT3G23170, AT3G23172, AT3G23245, AT3G23290, AT3G23295, AT3G23440, AT3G23590, AT3G23650, AT3G23715, AT3G23720, AT3G23727, AT3G23740, AT3G23850, AT3G23860, AT3G23910, AT3G24160, AT3G24180, AT3G24225, AT3G24250, AT3G24255, AT3G24280, AT3G24380, AT3G24490, AT3G24506, AT3G24508, AT3G24510, AT3G24513, AT3G24517, AT3G24535, AT3G24630, AT3G24640, AT3G24680, AT3G24690, AT3G24750, AT3G24770, AT3G24780, AT3G25080, AT3G25130, AT3G25200, AT3G25400, AT3G25545, AT3G25590, AT3G25597, AT3G25640, AT3G25655, AT3G25690, AT3G25720, AT3G25727, AT3G25805, AT3G25870, AT3G25882, AT3G25905, AT3G26000, AT3G26110, AT3G26235, AT3G26616, AT3G26710, AT3G26750, AT3G26800, AT3G26850, AT3G26855, AT3G26890, AT3G26910, AT3G26950, AT3G26960, AT3G27025, AT3G27030, AT3G27050, AT3G27100, AT3G27130, AT3G27210, AT3G27250, AT3G27350, AT3G27370, AT3G27390, AT3G27420, AT3G27520, AT3G27590, AT3G27630, AT3G27750, AT3G27770, AT3G27800, AT3G27906, AT3G27930, AT3G27990, AT3G28020, AT3G28110, AT3G28120, AT3G28155, AT3G28170, AT3G28190, AT3G28240, AT3G28260, AT3G28280, AT3G28350, AT3G28370, AT3G28420, AT3G28455, AT3G28530, AT3G28560, AT3G28590, AT3G28670, AT3G28720, AT3G28770, AT3G29010, AT3G29033, AT3G29034, AT3G29075, AT3G29080, AT3G29130, AT3G29140, AT3G29185, AT3G29210, AT3G29220, AT3G29265, AT3G29280, AT3G29300, AT3G29305, AT3G29385, AT3G29420, AT3G29450, AT3G29470, AT3G29560, AT3G29570, AT3G29600, AT3G29610, AT3G29636, AT3G29700, AT3G29763, AT3G29785, AT3G29786, AT3G29790, AT3G29796, AT3G30150, AT3G30160, AT3G30190, AT3G30200, AT3G30220, AT3G30250, AT3G30320, AT3G30350, AT3G30360, AT3G30370, AT3G30490, AT3G30510, AT3G30520, AT3G30580, AT3G30590, AT3G30610, AT3G30645, AT3G30650, AT3G30660, AT3G30670, AT3G30690, AT3G30700, AT3G30720, AT3G30725, AT3G30730, AT3G30750, AT3G30751, AT3G30755, AT3G30816, AT3G30820, AT3G30840, AT3G30843, AT3G30845, AT3G30848, AT3G31300, AT3G31310, AT3G31320, AT3G31330, AT3G31350, AT3G31370, AT3G31400, AT3G31406, AT3G31430, AT3G31540, AT3G31900, AT3G31910, AT3G31915, AT3G31940, AT3G31955, AT3G32050, AT3G32070, AT3G32100, AT3G32120, AT3G32150, AT3G32160, AT3G32180, AT3G32190, AT3G32200, AT3G32330, AT3G32410, AT3G32896, AT3G32902, AT3G32903, AT3G32904, AT3G32930, AT3G32960, AT3G33064, AT3G33073, AT3G33080, AT3G33131, AT3G33187, AT3G33230, AT3G33293, AT3G33393, AT3G33448, AT3G33494, AT3G33572, AT3G42070, AT3G42090, AT3G42120, AT3G42130, AT3G42140, AT3G42190, AT3G42200, AT3G42240, AT3G42250, AT3G42254, AT3G42300, AT3G42310, AT3G42320, AT3G42350, AT3G42380, AT3G42390, AT3G42430, AT3G42436, AT3G42473, AT3G42480, AT3G42490, AT3G42510, AT3G42520, AT3G42540, AT3G42556, AT3G42560, AT3G42590, AT3G42610, AT3G42680, AT3G42700, AT3G42723, AT3G42725, AT3G42740

, AT3G42750, AT3G42780, AT3G42786, AT3G42800, AT3G42810, AT3G42870, AT3G42920, AT3G42970, AT3G42990, AT3G43110, AT3G43140, AT3G43150, AT3G43153, AT3G43160, AT3G43260, AT3G43280, AT3G43290, AT3G43330, AT3G43410, AT3G43420, AT3G43450, AT3G43470, AT3G43480, AT3G43500, AT3G43528, AT3G43580, AT3G43583, AT3G43680, AT3G43682, AT3G43760, AT3G43770, AT3G43833, AT3G43850, AT3G43863, AT3G43870, AT3G43880, AT3G43900, AT3G43910, AT3G43930, AT3G43940, AT3G43970, AT3G44020, AT3G44040, AT3G44070, AT3G44115, AT3G44140, AT3G44150, AT3G44170, AT3G44210, AT3G44230, AT3G44235, AT3G44280, AT3G44370, AT3G44430, AT3G44440, AT3G44450, AT3G44470, AT3G44570, AT3G44580, AT3G44690, AT3G44716, AT3G44750, AT3G44755, AT3G44760, AT3G44770, AT3G44935, AT3G44950, AT3G44960, AT3G44980, AT3G45040, AT3G45050, AT3G45093, AT3G45110, AT3G45120, AT3G45160, AT3G45200, AT3G45230, AT3G45320, AT3G45360, AT3G45370, AT3G45443, AT3G45577, AT3G45730, AT3G45755, AT3G45820, AT3G45830, AT3G45900, AT3G45910, AT3G46150, AT3G46220, AT3G46240, AT3G46270, AT3G46300, AT3G46310, AT3G46360, AT3G46380, AT3G46390, AT3G46430, AT3G46630, AT3G46750, AT3G46880, AT3G46890, AT3G47070, AT3G47100, AT3G47230, AT3G47240, AT3G47295, AT3G47320, AT3G47410, AT3G47490, AT3G47510, AT3G47630, AT3G47675, AT3G47833, AT3G47836, AT3G47850, AT3G47920, AT3G47965, AT3G48020, AT3G48120, AT3G48180, AT3G48185, AT3G48200, AT3G48220, AT3G48231, AT3G48470, AT3G48490, AT3G48510, AT3G48550, AT3G48630, AT3G48640, AT3G48660, AT3G48675, AT3G48710, AT3G48860, AT3G49055, AT3G49230, AT3G49250, AT3G49270, AT3G49280, AT3G49290, AT3G49300, AT3G49305, AT3G49307, AT3G49410, AT3G49460, AT3G49490, AT3G49540, AT3G49550, AT3G49570, AT3G49580, AT3G49590, AT3G49770, AT3G49790, AT3G49820, AT3G49840, AT3G49890, AT3G49990, AT3G50040, AT3G50250, AT3G50320, AT3G50340, AT3G50370, AT3G50373, AT3G50376, AT3G50430, AT3G50540, AT3G50550, AT3G50570, AT3G50580, AT3G50610, AT3G50640, AT3G50685, AT3G50800, AT3G50900, AT3G50910, AT3G50925, AT3G51010, AT3G51100, AT3G51230, AT3G51290, AT3G51350, AT3G51500, AT3G51510, AT3G51540, AT3G51580, AT3G51610, AT3G51640, AT3G51650, AT3G51750, AT3G51890, AT3G51970, AT3G52040, AT3G52070, AT3G52105, AT3G52110, AT3G52115, AT3G52170, AT3G52220, AT3G52230, AT3G52240, AT3G52360, AT3G52420, AT3G52480, AT3G52520, AT3G52540, AT3G52550, AT3G52620, AT3G52700, AT3G52710, AT3G52740, AT3G52770, AT3G52860, AT3G53235, AT3G53270, AT3G53320, AT3G53350, AT3G53470, AT3G53540, AT3G53630, AT3G53670, AT3G53860, AT3G53970, AT3G54000, AT3G54060, AT3G54170, AT3G54310, AT3G54500, AT3G54520, AT3G54530, AT3G54630, AT3G54680, AT3G54710, AT3G54730, AT3G54750, AT3G54880, AT3G55060, AT3G55160, AT3G55250, AT3G55420, AT3G55570, AT3G55600, AT3G55646, AT3G55690, AT3G55720, AT3G55760, AT3G55790, AT3G55860, AT3G55880, AT3G55910, AT3G55930, AT3G56010, AT3G56160, AT3G56220, AT3G56250, AT3G56260, AT3G56290, AT3G56360, AT3G56390, AT3G56410, AT3G56430, AT3G56480, AT3G56500, AT3G56590, AT3G56610, AT3G56650, AT3G56670, AT3G56720, AT3G56750, AT3G56790, AT3G56870, AT3G56910, AT3G57110, AT3G57160, AT3G57200, AT3G57210, AT3G57320, AT3G57360, AT3G57400, AT3G57420, AT3G57440, AT3G57450, AT3G57500, AT3G57690, AT3G57780, AT3G57785, AT3G57850, AT3G57860, AT3G57930, AT3G57950, AT3G57990, AT3G58010, AT3G58020, AT3G58050, AT3G58080, AT3G58110, AT3G58230, AT3G58280, AT3G58300, AT3G58320, AT

3G58330, AT3G58470, AT3G58480, AT3G58540, AT3G58770, AT3G58840, AT3G58870, AT3G59090, AT3G59300, AT3G59370, AT3G59390, AT3G59430, AT3G59460, AT3G59490, AT3G59640, AT3G59680, AT3G59800, AT3G59840, AT3G59870, AT3G59880, AT3G59900, AT3G59930, AT3G60070, AT3G60200, AT3G60230, AT3G60310, AT3G60320, AT3G60380, AT3G60480, AT3G60520, AT3G60560, AT3G60590, AT3G60650, AT3G60680, AT3G60760, AT3G60850, AT3G60890, AT3G60930, AT3G61370, AT3G61380, AT3G61500, AT3G61570, AT3G61660, AT3G61670, AT3G61710, AT3G61780, AT3G61840, AT3G61870, AT3G61898, AT3G61920, AT3G61930, AT3G62070, AT3G62140, AT3G62320, AT3G62350, AT3G62370, AT3G62380, AT3G62400, AT3G62450, AT3G62480, AT3G62490, AT3G62500, AT3G62510, AT3G62580, AT3G62640, AT3G62650, AT3G62680, AT3G62730, AT3G62790, AT3G62920, AT3G62990, AT3G63020, AT3G63040, AT3G63050, AT3G63100, AT3G63160, AT3G63180, AT3G63270, AT3G63420, AT3G63430, AT4G00280, AT4G00310, AT4G00355, AT4G00440, AT4G00450, AT4G00525, AT4G00530, AT4G00580, AT4G00585, AT4G00695, AT4G00770, AT4G00890, AT4G00920, AT4G00930, AT4G00950, AT4G00955, AT4G01090, AT4G01150, AT4G01170, AT4G01245, AT4G01290, AT4G01340, AT4G01360, AT4G01500, AT4G01525, AT4G01530, AT4G01535, AT4G01590, AT4G01670, AT4G01735, AT4G01895, AT4G01915, AT4G01935, AT4G01960, AT4G01985, AT4G01995, AT4G02000, AT4G02030, AT4G02040, AT4G02090, AT4G02140, AT4G02160, AT4G02170, AT4G02210, AT4G02270, AT4G02425, AT4G02465, AT4G02482, AT4G02530, AT4G02550, AT4G02715, AT4G02725, AT4G02760, AT4G02800, AT4G02810, AT4G02830, AT4G02870, AT4G02880, AT4G02920, AT4G03090, AT4G03150, AT4G03165, AT4G03180, AT4G03305, AT4G03380, AT4G03505, AT4G03580, AT4G03600, AT4G03620, AT4G03680, AT4G03740, AT4G03750, AT4G03820, AT4G03940, AT4G03970, AT4G03975, AT4G03979, AT4G04030, AT4G04155, AT4G04190, AT4G04273, AT4G04330, AT4G04394, AT4G04396, AT4G04398, AT4G04423, AT4G04470, AT4G04480, AT4G04525, AT4G04614, AT4G04635, AT4G04650, AT4G04730, AT4G04745, AT4G04820, AT4G04925, AT4G04980, AT4G05070, AT4G05095, AT4G05145, AT4G05290, AT4G05370, AT4G05400, AT4G05523, AT4G05553, AT4G05560, AT4G05580, AT4G05581, AT4G05616, AT4G05631, AT4G05632, AT4G05636, AT4G05640, AT4G06490, AT4G06534, AT4G06603, AT4G06637, AT4G06672, AT4G06676, AT4G06716, AT4G06724, AT4G06728, AT4G06735, AT4G06740, AT4G07380, AT4G07452, AT4G07460, AT4G07485, AT4G07500, AT4G07515, AT4G07523, AT4G07524, AT4G07526, AT4G07666, AT4G07675, AT4G07740, AT4G07800, AT4G07825, AT4G07868, AT4G07932, AT4G07940, AT4G07943, AT4G07965, AT4G08013, AT4G08025, AT4G08028, AT4G08039, AT4G08056, AT4G08097, AT4G08098, AT4G08111, AT4G08130, AT4G08140, AT4G08200, AT4G08230, AT4G08240, AT4G08270, AT4G08310, AT4G08330, AT4G08336, AT4G08395, AT4G08485, AT4G08510, AT4G08540, AT4G08555, AT4G08593, AT4G08602, AT4G08630, AT4G08710, AT4G08730, AT4G08740, AT4G08760, AT4G08810, AT4G08820, AT4G08868, AT4G08869, AT4G08874, AT4G08875, AT4G08876, AT4G08895, AT4G08910, AT4G09030, AT4G09060, AT4G09070, AT4G09153, AT4G09170, AT4G09210, AT4G09220, AT4G09260, AT4G09270, AT4G09290, AT4G09390, AT4G09550, AT4G09580, AT4G09630, AT4G09647, AT4G09680, AT4G09700, AT4G09840, AT4G09850, AT4G09860, AT4G09880, AT4G09890, AT4G09965, AT4G09970, AT4G09984, AT4G10060, AT4G10080, AT4G10090, AT4G10140, AT4G10180, AT4G10230, AT4G10265, AT4G10270, AT4G10330, AT4G10613, AT4G10660, AT4G10670, AT4G10700, AT4G10800, AT4G1

0810, AT4G10820, AT4G10845, AT4G10860, AT4G10870, AT4G10890, AT4G10910, AT4G10930, AT4G10970, AT4G11020, AT4G11100, AT4G11211, AT4G11385, AT4G11393, AT4G11430, AT4G11700, AT4G11720, AT4G11780, AT4G11870, AT4G11910, AT4G11940, AT4G11990, AT4G12000, AT4G12005, AT4G12070, AT4G12220, AT4G12350, AT4G12370, AT4G12380, AT4G12540, AT4G12580, AT4G12680, AT4G12700, AT4G12735, AT4G12760, AT4G12770, AT4G12780, AT4G12930, AT4G12940, AT4G12970, AT4G12990, AT4G13095, AT4G13140, AT4G13150, AT4G13195, AT4G13200, AT4G13220, AT4G13235, AT4G13266, AT4G13270, AT4G13320, AT4G13340, AT4G13470, AT4G13500, AT4G13520, AT4G13530, AT4G13540, AT4G13690, AT4G13740, AT4G13955, AT4G13968, AT4G14100, AT4G14104, AT4G14120, AT4G14200, AT4G14270, AT4G14272, AT4G14276, AT4G14315, AT4G14380, AT4G14385, AT4G14450, AT4G14530, AT4G14590, AT4G14615, AT4G14650, AT4G14690, AT4G14723, AT4G14760, AT4G14810, AT4G14950, AT4G14970, AT4G14990, AT4G15030, AT4G15096, AT4G15140, AT4G15150, AT4G15160, AT4G15460, AT4G15540, AT4G15563, AT4G15640, AT4G15650, AT4G15710, AT4G15733, AT4G15735, AT4G15820, AT4G15885, AT4G15950, AT4G15970, AT4G15990, AT4G16000, AT4G16040, AT4G16060, AT4G16090, AT4G16140, AT4G16170, AT4G16215, AT4G16240, AT4G16320, AT4G16400, AT4G16444, AT4G16447, AT4G16450, AT4G16460, AT4G16515, AT4G16695, AT4G16810, AT4G16840, AT4G16845, AT4G16850, AT4G16980, AT4G17000, AT4G17010, AT4G17110, AT4G17130, AT4G17215, AT4G17240, AT4G17250, AT4G17310, AT4G17430, AT4G17540, AT4G17590, AT4G17600, AT4G17620, AT4G17700, AT4G17713, AT4G17790, AT4G17930, AT4G17960, AT4G17990, AT4G18000, AT4G18070, AT4G18080, AT4G18090, AT4G18140, AT4G18280, AT4G18310, AT4G18320, AT4G18335, AT4G18395, AT4G18400, AT4G18420, AT4G18470, AT4G18490, AT4G18500, AT4G18501, AT4G18510, AT4G18540, AT4G18570, AT4G18580, AT4G18593, AT4G18600, AT4G18610, AT4G18650, AT4G18660, AT4G18670, AT4G18680, AT4G18690, AT4G18823, AT4G18830, AT4G18850, AT4G18860, AT4G19070, AT4G19095, AT4G19100, AT4G19140, AT4G19160, AT4G19190, AT4G19200, AT4G19240, AT4G19270, AT4G19280, AT4G19290, AT4G19305, AT4G19320, AT4G19350, AT4G19360, AT4G19430, AT4G19480, AT4G19620, AT4G19905, AT4G19950, AT4G19980, AT4G20020, AT4G20095, AT4G20150, AT4G20160, AT4G20190, AT4G20250, AT4G20290, AT4G20330, AT4G20350, AT4G20390, AT4G20470, AT4G20500, AT4G20510, AT4G20690, AT4G20715, AT4G20720, AT4G20880, AT4G21010, AT4G21105, AT4G21140, AT4G21215, AT4G21445, AT4G21460, AT4G21500, AT4G21620, AT4G21700, AT4G21720, AT4G21740, AT4G21780, AT4G21865, AT4G21890, AT4G21920, AT4G21950, AT4G22000, AT4G22160, AT4G22190, AT4G22210, AT4G22214, AT4G22217, AT4G22235, AT4G22270, AT4G22320, AT4G22400, AT4G22420, AT4G22430, AT4G22440, AT4G22470, AT4G22510, AT4G22600, AT4G22740, AT4G22800, AT4G22830, AT4G22850, AT4G22860, AT4G22920, AT4G22980, AT4G23020, AT4G23090, AT4G23110, AT4G23330, AT4G23493, AT4G23496, AT4G23610, AT4G23760, AT4G23770, AT4G23780, AT4G23870, AT4G23880, AT4G23885, AT4G23890, AT4G23910, AT4G23970, AT4G23980, AT4G24030, AT4G24110, AT4G24150, AT4G24175, AT4G24265, AT4G24275, AT4G24300, AT4G24370, AT4G24410, AT4G24500, AT4G24590, AT4G24600, AT4G24610, AT4G24680, AT4G24700, AT4G24720, AT4G24900, AT4G24930, AT4G24950, AT4G24972, AT4G24980, AT4G25030, AT4G25070, AT4G25170, AT4G25315, AT4G25430, AT4G25510, AT4G25515, AT4G25520, AT4G25620, AT4G25670, AT4G25690, AT4G25760, AT4G2584

5, AT4G26020, AT4G26030, AT4G26040, AT4G26060, AT4G26130, AT4G26170, AT4G26190, AT4G26240, AT4G26290, AT4G26320, AT4G26410, AT4G26450, AT4G26630, AT4G26850, AT4G26960, AT4G26965, AT4G27020, AT4G27030, AT4G27120, AT4G27330, AT4G27380, AT4G27390, AT4G27410, AT4G27415, AT4G27430, AT4G27500, AT4G27510, AT4G27530, AT4G27580, AT4G27595, AT4G27610, AT4G27630, AT4G27652, AT4G27654, AT4G27657, AT4G27660, AT4G27810, AT4G27850, AT4G27930, AT4G27980, AT4G28005, AT4G28025, AT4G28085, AT4G28100, AT4G28160, AT4G28170, AT4G28180, AT4G28190, AT4G28210, AT4G28230, AT4G28240, AT4G28260, AT4G28280, AT4G28290, AT4G28310, AT4G28330, AT4G28340, AT4G28460, AT4G28690, AT4G28740, AT4G28760, AT4G28770, AT4G28810, AT4G28840, AT4G28870, AT4G28920, AT4G28930, AT4G29020, AT4G29030, AT4G29200, AT4G29273, AT4G29280, AT4G29285, AT4G29290, AT4G29300, AT4G29305, AT4G29520, AT4G29560, AT4G29660, AT4G29780, AT4G29790, AT4G29870, AT4G29960, AT4G30010, AT4G30050, AT4G30064, AT4G30070, AT4G30074, AT4G30090, AT4G30130, AT4G30150, AT4G30230, AT4G30390, AT4G30450, AT4G30460, AT4G30630, AT4G30662, AT4G30670, AT4G30730, AT4G30740, AT4G30750, AT4G30770, AT4G30780, AT4G30790, AT4G30970, AT4G30993, AT4G31030, AT4G31080, AT4G31090, AT4G31115, AT4G31260, AT4G31280, AT4G31340, AT4G31380, AT4G31430, AT4G31440, AT4G31510, AT4G31550, AT4G31560, AT4G31570, AT4G31600, AT4G31730, AT4G31805, AT4G31830, AT4G31875, AT4G31880, AT4G31960, AT4G32020, AT4G32030, AT4G32080, AT4G32090, AT4G32100, AT4G32105, AT4G32110, AT4G32190, AT4G32230, AT4G32240, AT4G32460, AT4G32560, AT4G32590, AT4G32680, AT4G32695, AT4G32770, AT4G32860, AT4G32960, AT4G32970, AT4G33130, AT4G33310, AT4G33320, AT4G33380, AT4G33480, AT4G33560, AT4G33590, AT4G33600, AT4G33610, AT4G33625, AT4G33640, AT4G33660, AT4G33666, AT4G33690, AT4G33740, AT4G33750, AT4G33780, AT4G33800, AT4G33890, AT4G33925, AT4G33960, AT4G33970, AT4G33980, AT4G34080, AT4G34090, AT4G34190, AT4G34265, AT4G34412, AT4G34550, AT4G34560, AT4G34600, AT4G34630, AT4G34690, AT4G35170, AT4G35240, AT4G35295, AT4G35360, AT4G35400, AT4G35430, AT4G35510, AT4G35530, AT4G35725, AT4G35940, AT4G35980, AT4G35987, AT4G36100, AT4G36105, AT4G36170, AT4G36370, AT4G36440, AT4G36460, AT4G36500, AT4G36510, AT4G36515, AT4G36520, AT4G36560, AT4G36830, AT4G36925, AT4G36980, AT4G37030, AT4G37090, AT4G37110, AT4G37130, AT4G37240, AT4G37290, AT4G37295, AT4G37300, AT4G37440, AT4G37445, AT4G37450, AT4G37685, AT4G37700, AT4G37740, AT4G37810, AT4G37820, AT4G37920, AT4G37925, AT4G38060, AT4G38070, AT4G38080, AT4G38100, AT4G38120, AT4G38225, AT4G38280, AT4G38330, AT4G38490, AT4G38500, AT4G38680, AT4G38750, AT4G38760, AT4G38820, AT4G38980, AT4G39190, AT4G39235, AT4G39300, AT4G39320, AT4G39360, AT4G39380, AT4G39403, AT4G39420, AT4G39430, AT4G39440, AT4G39450, AT4G39610, AT4G39630, AT4G39670, AT4G39675, AT4G39690, AT4G39745, AT4G39750, AT4G39790, AT4G39840, AT4G39860, AT4G39900, AT4G39917, AT4G39920, AT4G39930, AT4G40020, AT4G40045, AT4G40090, AT5G01015, AT5G01030, AT5G01075, AT5G01080, AT5G01225, AT5G01280, AT5G01350, AT5G01370, AT5G01570, AT5G01690, AT5G01730, AT5G01790, AT5G01840, AT5G01881, AT5G01910, AT5G01970, AT5G02000, AT5G02020, AT5G02090, AT5G02120, AT5G02160, AT5G02200, AT5G02220, AT5G02390, AT5G02420, AT5G02440, AT5G02502, AT5G02510, AT5G02520, AT5G02550, AT5G02640, AT5G02650, AT5G02660, AT5G02680, A

T5G02690, AT5G02720, AT5G02740, AT5G02770, AT5G02850, AT5G03050, AT5G03060, AT5G03090, AT5G03110, AT5G03120, AT5G03130, AT5G03210, AT5G03345, AT5G03400, AT5G03420, AT5G03440, AT5G03460, AT5G03545, AT5G03550, AT5G03560, AT5G03670, AT5G03710, AT5G03740, AT5G03750, AT5G03830, AT5G03890, AT5G03900, AT5G03920, AT5G03930, AT5G03950, AT5G03990, AT5G04000, AT5G04030, AT5G04045, AT5G04080, AT5G04090, AT5G04190, AT5G04290, AT5G04470, AT5G04520, AT5G04650, AT5G04670, AT5G04730, AT5G04750, AT5G04790, AT5G04840, AT5G04860, AT5G04910, AT5G05020, AT5G05180, AT5G05190, AT5G05220, AT5G05240, AT5G05250, AT5G05300, AT5G05310, AT5G05360, AT5G05480, AT5G05640, AT5G05660, AT5G05800, AT5G05840, AT5G05930, AT5G05950, AT5G05965, AT5G06010, AT5G06043, AT5G06190, AT5G06240, AT5G06265, AT5G06270, AT5G06280, AT5G06380, AT5G06590, AT5G06610, AT5G06710, AT5G06790, AT5G06890, AT5G06930, AT5G06980, AT5G06990, AT5G07020, AT5G07170, AT5G07330, AT5G07380, AT5G07490, AT5G07570, AT5G07730, AT5G07790, AT5G07890, AT5G07940, AT5G07950, AT5G07970, AT5G07980, AT5G08010, AT5G08040, AT5G08055, AT5G08060, AT5G08090, AT5G08120, AT5G08150, AT5G08185, AT5G08210, AT5G08220, AT5G08240, AT5G08270, AT5G08315, AT5G08320, AT5G08400, AT5G08450, AT5G08505, AT5G08540, AT5G08770, AT5G09225, AT5G09270, AT5G09310, AT5G09390, AT5G09480, AT5G09520, AT5G09530, AT5G09670, AT5G09860, AT5G09960, AT5G09980, AT5G09990, AT5G09995, AT5G10010, AT5G10040, AT5G10110, AT5G10310, AT5G10320, AT5G10430, AT5G10590, AT5G10660, AT5G10670, AT5G10680, AT5G10700, AT5G10710, AT5G10745, AT5G10850, AT5G10890, AT5G10950, AT5G11030, AT5G11070, AT5G11090, AT5G11120, AT5G111220, AT5G11280, AT5G11390, AT5G11420, AT5G11530, AT5G11600, AT5G11630, AT5G11680, AT5G11760, AT5G11780, AT5G11810, AT5G11830, AT5G11870, AT5G11970, AT5G11990, AT5G12010, AT5G12050, AT5G12160, AT5G12170, AT5G12230, AT5G12235, AT5G12240, AT5G12290, AT5G12340, AT5G12360, AT5G12430, AT5G12470, AT5G12880, AT5G12930, AT5G12990, AT5G13090, AT5G13240, AT5G13250, AT5G13260, AT5G13310, AT5G13340, AT5G13390, AT5G13470, AT5G13500, AT5G13540, AT5G13560, AT5G13590, AT5G13610, AT5G13620, AT5G13655, AT5G13660, AT5G13825, AT5G13880, AT5G13940, AT5G13950, AT5G13970, AT5G14020, AT5G14090, AT5G14105, AT5G14110, AT5G14150, AT5G14210, AT5G14290, AT5G14330, AT5G14380, AT5G14410, AT5G14560, AT5G14690, AT5G14710, AT5G14730, AT5G14920, AT5G14930, AT5G14970, AT5G14990, AT5G15000, AT5G15190, AT5G15260, AT5G15320, AT5G15360, AT5G15420, AT5G15560, AT5G15600, AT5G15725, AT5G15780, AT5G15802, AT5G15960, AT5G15970, AT5G15990, AT5G16030, AT5G16060, AT5G16100, AT5G16110, AT5G16160, AT5G16200, AT5G16250, AT5G16453, AT5G16470, AT5G16486, AT5G16520, AT5G16550, AT5G16610, AT5G16660, AT5G16730, AT5G16940, AT5G16950, AT5G17070, AT5G17130, AT5G17160, AT5G17190, AT5G17280, AT5G17340, AT5G17360, AT5G17460, AT5G17510, AT5G17520, AT5G17590, AT5G17610, AT5G17650, AT5G17870, AT5G17910, AT5G18130, AT5G18150, AT5G18250, AT5G18310, AT5G18403, AT5G18407, AT5G18420, AT5G18440, AT5G18540, AT5G18636, AT5G18690, AT5G18710, AT5G18720, AT5G18730, AT5G18740, AT5G18850, AT5G18880, AT5G19070, AT5G19172, AT5G19190, AT5G19230, AT5G19260, AT5G19315, AT5G19340, AT5G19480, AT5G19540, AT5G19570, AT5G19710, AT5G19800, AT5G19810, AT5G19875, AT5G19900, AT5G19950, AT5G19970, AT5G19980, AT5G20045, AT5G20100, AT5G20120, AT5G20130, AT5G

20170, AT5G20200, AT5G20370, AT5G20450, AT5G20460, AT5G20610, AT5G20635, AT5G20760, AT5G20770, AT5G20790, AT5G20820, AT5G20935, AT5G21020, AT5G21050, AT5G21070, AT5G21080, AT5G21110, AT5G21125, AT5G21280, AT5G21910, AT5G21940, AT5G22040, AT5G22090, AT5G22120, AT5G22150, AT5G22160, AT5G22170, AT5G22180, AT5G22190, AT5G22210, AT5G22270, AT5G22280, AT5G22310, AT5G22340, AT5G22390, AT5G22430, AT5G22450, AT5G22520, AT5G22530, AT5G22545, AT5G22555, AT5G22650, AT5G22680, AT5G22790, AT5G22875, AT5G22970, AT5G23035, AT5G23100, AT5G23110, AT5G23160, AT5G23180, AT5G23200, AT5G23212, AT5G23390, AT5G23410, AT5G23460, AT5G23490, AT5G23510, AT5G23610, AT5G23640, AT5G23700, AT5G23890, AT5G23920, AT5G24060, AT5G24130, AT5G24165, AT5G24250, AT5G24310, AT5G24313, AT5G24314, AT5G24316, AT5G24355, AT5G24450, AT5G24480, AT5G24500, AT5G24570, AT5G24590, AT5G24610, AT5G24630, AT5G24640, AT5G24655, AT5G24690, AT5G24740, AT5G24860, AT5G24880, AT5G24890, AT5G24920, AT5G24980, AT5G25000, AT5G25070, AT5G25200, AT5G25210, AT5G25240, AT5G25250, AT5G25260, AT5G25265, AT5G25270, AT5G25280, AT5G25360, AT5G25425, AT5G25460, AT5G25500, AT5G25570, AT5G25580, AT5G25590, AT5G25600, AT5G25750, AT5G25754, AT5G25757, AT5G25870, AT5G25920, AT5G26020, AT5G26070, AT5G26080, AT5G26100, AT5G26160, AT5G26230, AT5G26270, AT5G26350, AT5G26620, AT5G26622, AT5G26640, AT5G26650, AT5G26692, AT5G26717, AT5G26720, AT5G26731, AT5G26760, AT5G26770, AT5G26790, AT5G26800, AT5G26805, AT5G26820, AT5G26840, AT5G26850, AT5G26890, AT5G26970, AT5G27020, AT5G27170, AT5G27180, AT5G27210, AT5G27260, AT5G27290, AT5G27330, AT5G27340, AT5G27440, AT5G27500, AT5G27590, AT5G27606, AT5G27710, AT5G27730, AT5G27760, AT5G27800, AT5G27860, AT5G27890, AT5G27940, AT5G27990, AT5G28070, AT5G28090, AT5G28110, AT5G28120, AT5G28130, AT5G28140, AT5G28170, AT5G28190, AT5G28240, AT5G28270, AT5G28295, AT5G28320, AT5G28400, AT5G28410, AT5G28420, AT5G28430, AT5G28440, AT5G28463, AT5G28480, AT5G28482, AT5G28484, AT5G28490, AT5G28500, AT5G28550, AT5G28560, AT5G28600, AT5G28610, AT5G28615, AT5G28620, AT5G28623, AT5G28630, AT5G28720, AT5G28730, AT5G28785, AT5G28790, AT5G28800, AT5G28810, AT5G28820, AT5G28823, AT5G28860, AT5G28910, AT5G28920, AT5G28950, AT5G28960, AT5G28990, AT5G29020, AT5G29050, AT5G29070, AT5G29090, AT5G29210, AT5G29576, AT5G29602, AT5G29613, AT5G30341, AT5G30495, AT5G30520, AT5G31685, AT5G31752, AT5G31753, AT5G31787, AT5G31838, AT5G31873, AT5G32161, AT5G32169, AT5G32312, AT5G32405, AT5G32410, AT5G32590, AT5G32600, AT5G32605, AT5G32610, AT5G32619, AT5G32621, AT5G32775, AT5G33230, AT5G33300, AT5G33303, AT5G33355, AT5G33380, AT5G33390, AT5G33393, AT5G33715, AT5G33806, AT5G33898, AT5G34358, AT5G34450, AT5G34540, AT5G34581, AT5G34820, AT5G34830, AT5G34838, AT5G34860, AT5G34881, AT5G34883, AT5G34887, AT5G34905, AT5G34910, AT5G34970, AT5G34980, AT5G35010, AT5G35020, AT5G35035, AT5G35080, AT5G35090, AT5G35110, AT5G35120, AT5G35195, AT5G35230, AT5G35270, AT5G35290, AT5G35300, AT5G35320, AT5G35460, AT5G35470, AT5G35475, AT5G35480, AT5G35490, AT5G35510, AT5G35540, AT5G35603, AT5G35604, AT5G35646, AT5G35695, AT5G35732, AT5G35737, AT5G35753, AT5G35760, AT5G35792, AT5G35870, AT5G35880, AT5G35890, AT5G35945, AT5G36001, AT5G36020, AT5G36035, AT5G36040, AT5G36060, AT5G36070, AT5G36080, AT5G36100, AT5G36190, AT5G36228, AT5G36280, AT5G366

50, AT5G36690, AT5G36710, AT5G36720, AT5G36735, AT5G36780, AT5G36800, AT5G36810, AT5G36900, AT5G36920, AT5G36925, AT5G36960, AT5G37010, AT5G37050, AT5G37120, AT5G37190, AT5G37240, AT5G37360, AT5G37385, AT5G37473, AT5G37474, AT5G37475, AT5G37478, AT5G37480, AT5G37550, AT5G37730, AT5G37840, AT5G37880, AT5G38050, AT5G38060, AT5G38080, AT5G38090, AT5G38190, AT5G38300, AT5G38310, AT5G38317, AT5G38320, AT5G38330, AT5G38380, AT5G38400, AT5G38595, AT5G38660, AT5G38720, AT5G38750, AT5G38770, AT5G38790, AT5G38880, AT5G38980, AT5G39140, AT5G39170, AT5G39200, AT5G39205, AT5G39210, AT5G39240, AT5G39365, AT5G39520, AT5G39530, AT5G39570, AT5G39600, AT5G39790, AT5G39800, AT5G39880, AT5G40070, AT5G40080, AT5G40110, AT5G40155, AT5G40180, AT5G40450, AT5G40460, AT5G40500, AT5G40520, AT5G40595, AT5G40600, AT5G40620, AT5G40640, AT5G40690, AT5G40700, AT5G40710, AT5G40730, AT5G40740, AT5G40800, AT5G40855, AT5G40900, AT5G40960, AT5G40970, AT5G40980, AT5G41020, AT5G41100, AT5G41110, AT5G41140, AT5G41190, AT5G41270, AT5G41320, AT5G41505, AT5G41560, AT5G41620, AT5G41640, AT5G41660, AT5G41780, AT5G41790, AT5G41810, AT5G41860, AT5G41910, AT5G41960, AT5G41980, AT5G42030, AT5G42060, AT5G42070, AT5G42110, AT5G42146, AT5G42223, AT5G42232, AT5G42235, AT5G42242, AT5G42290, AT5G42330, AT5G42530, AT5G42635, AT5G42660, AT5G42710, AT5G42750, AT5G42765, AT5G42780, AT5G42785, AT5G42797, AT5G42825, AT5G42900, AT5G42920, AT5G42955, AT5G42957, AT5G42960, AT5G43000, AT5G43070, AT5G43150, AT5G43185, AT5G43230, AT5G43260, AT5G43285, AT5G43310, AT5G43401, AT5G43405, AT5G43480, AT5G43490, AT5G43510, AT5G43513, AT5G43720, AT5G43750, AT5G43770, AT5G43880, AT5G43970, AT5G44005, AT5G44010, AT5G44040, AT5G44060, AT5G44150, AT5G44313, AT5G44350, AT5G44565, AT5G44570, AT5G44575, AT5G44580, AT5G44650, AT5G44660, AT5G44780, AT5G44820, AT5G44860, AT5G44880, AT5G44973, AT5G45113, AT5G45330, AT5G45350, AT5G45410, AT5G45460, AT5G45573, AT5G45660, AT5G45710, AT5G45740, AT5G45830, AT5G46020, AT5G46115, AT5G46120, AT5G46220, AT5G46295, AT5G46300, AT5G46310, AT5G46320, AT5G46440, AT5G46500, AT5G46620, AT5G46730, AT5G46770, AT5G46795, AT5G46871, AT5G46873, AT5G46874, AT5G46877, AT5G47090, AT5G47110, AT5G47170, AT5G47400, AT5G47410, AT5G47455, AT5G47480, AT5G47490, AT5G47570, AT5G47580, AT5G47635, AT5G47830, AT5G47870, AT5G47920, AT5G47940, AT5G48080, AT5G48175, AT5G48200, AT5G48205, AT5G48210, AT5G48280, AT5G48310, AT5G48335, AT5G48340, AT5G48420, AT5G48470, AT5G48500, AT5G48515, AT5G48520, AT5G48530, AT5G48595, AT5G48605, AT5G48610, AT5G48657, AT5G48720, AT5G48790, AT5G48830, AT5G48860, AT5G48920, AT5G48953, AT5G49015, AT5G49090, AT5G49100, AT5G49110, AT5G49170, AT5G49210, AT5G49250, AT5G49260, AT5G49280, AT5G49380, AT5G49400, AT5G49410, AT5G49440, AT5G49525, AT5G49550, AT5G49590, AT5G49640, AT5G49670, AT5G49680, AT5G49710, AT5G49790, AT5G49830, AT5G49900, AT5G50090, AT5G50175, AT5G50190, AT5G50200, AT5G50290, AT5G50335, AT5G50350, AT5G50360, AT5G50375, AT5G50410, AT5G50420, AT5G50500, AT5G50540, AT5G50560, AT5G50565, AT5G50610, AT5G50645, AT5G50660, AT5G50665, AT5G50710, AT5G50830, AT5G50840, AT5G50880, AT5G50910, AT5G51090, AT5G51105, AT5G51170, AT5G51195, AT5G51200, AT5G51230, AT5G51330, AT5G51390, AT5G51420, AT5G51430, AT5G51510, AT5G51530, AT5G51545, AT5G51580, AT5G51650, AT5G51680, AT5G51840, AT5G51845,

AT5G51850, AT5G51960, AT5G52065, AT5G52080, AT5G52110, AT5G52130, AT5G52140, AT5G52200, AT5G52220, AT5G52280, AT5G52290, AT5G52310, AT5G52410, AT5G52420, AT5G52430, AT5G52500, AT5G52530, AT5G52547, AT5G52550, AT5G52580, AT5G52605, AT5G52780, AT5G52800, AT5G52870, AT5G52890, AT5G52900, AT5G52950, AT5G52960, AT5G52965, AT5G52970, AT5G52975, AT5G52980, AT5G53020, AT5G53030, AT5G53045, AT5G53110, AT5G53220, AT5G53280, AT5G53410, AT5G53440, AT5G53620, AT5G53650, AT5G53660, AT5G53670, AT5G53690, AT5G53710, AT5G53740, AT5G53800, AT5G53860, AT5G53880, AT5G53895, AT5G53900, AT5G53905, AT5G53930, AT5G53960, AT5G54062, AT5G54067, AT5G54095, AT5G54145, AT5G54150, AT5G54215, AT5G54350, AT5G54410, AT5G54440, AT5G54460, AT5G54480, AT5G54540, AT5G54585, AT5G54790, AT5G54850, AT5G54870, AT5G54930, AT5G54950, AT5G54970, AT5G55010, AT5G55030, AT5G55060, AT5G55120, AT5G55131, AT5G55132, AT5G55135, AT5G55210, AT5G55330, AT5G55340, AT5G55350, AT5G55360, AT5G55370, AT5G55420, AT5G55430, AT5G55490, AT5G55500, AT5G55507, AT5G55610, AT5G55620, AT5G55640, AT5G55650, AT5G55660, AT5G55680, AT5G55710, AT5G55750, AT5G55790, AT5G55820, AT5G55870, AT5G55893, AT5G55980, AT5G56070, AT5G56075, AT5G56100, AT5G56120, AT5G56170, AT5G56210, AT5G56240, AT5G56250, AT5G56368, AT5G56369, AT5G56520, AT5G56540, AT5G56550, AT5G56770, AT5G56780, AT5G56795, AT5G56850, AT5G56880, AT5G57000, AT5G57060, AT5G57070, AT5G57080, AT5G57180, AT5G57310, AT5G57340, AT5G57345, AT5G57370, AT5G57400, AT5G57410, AT5G57420, AT5G57460, AT5G57500, AT5G57510, AT5G57650, AT5G57685, AT5G57730, AT5G57760, AT5G57790, AT5G57880, AT5G57887, AT5G57910, AT5G58100, AT5G58110, AT5G58210, AT5G58250, AT5G58260, AT5G58360, AT5G58375, AT5G58470, AT5G58500, AT5G58510, AT5G58570, AT5G58630, AT5G58650, AT5G58790, AT5G58880, AT5G58920, AT5G58960, AT5G59050, AT5G59060, AT5G59080, AT5G59105, AT5G59110, AT5G59170, AT5G59210, AT5G59305, AT5G59330, AT5G59350, AT5G59360, AT5G59460, AT5G59500, AT5G59613, AT5G59616, AT5G59830, AT5G59960, AT5G60000, AT5G60030, AT5G60150, AT5G60210, AT5G60240, AT5G60260, AT5G60290, AT5G60330, AT5G60350, AT5G60400, AT5G60430, AT5G60553, AT5G60630, AT5G60650, AT5G60805, AT5G60810, AT5G60840, AT5G60880, AT5G61040, AT5G61090, AT5G61110, AT5G61120, AT5G61200, AT5G61300, AT5G61340, AT5G61360, AT5G61490, AT5G61605, AT5G61630, AT5G61660, AT5G61710, AT5G61865, AT5G61920, AT5G61940, AT5G61950, AT5G61970, AT5G62090, AT5G62140, AT5G62170, AT5G62240, AT5G62270, AT5G62330, AT5G62400, AT5G62440, AT5G62550, AT5G62575, AT5G62623, AT5G62627, AT5G62640, AT5G62750, AT5G62760, AT5G62900, AT5G62960, AT5G63000, AT5G63040, AT5G63050, AT5G63135, AT5G63320, AT5G63340, AT5G63350, AT5G63500, AT5G63540, AT5G63550, AT5G63720, AT5G63740, AT5G63820, AT5G63830, AT5G63905, AT5G64010, AT5G64090, AT5G64130, AT5G64160, AT5G64170, AT5G64180, AT5G64190, AT5G64230, AT5G64310, AT5G64400, AT5G64480, AT5G64510, AT5G64520, AT5G64540, AT5G64550, AT5G64680, AT5G64690, AT5G64770, AT5G64780, AT5G64800, AT5G64816, AT5G64820, AT5G64850, AT5G64870, AT5G64880, AT5G64890, AT5G64900, AT5G64905, AT5G64930, AT5G65120, AT5G65180, AT5G65207, AT5G65250, AT5G65300, AT5G65340, AT5G65390, AT5G65480, AT5G65495, AT5G65540, AT5G65580, AT5G65610, AT5G65660, AT5G65770, AT5G65810, AT5G65880, AT5G65925, AT5G66000, AT5G66030, AT5G66052, AT5G66230, AT5G66250, AT5G66290, AT5

G66340, AT5G66440, AT5G66480, AT5G66490, AT5G66580, AT5G66640, AT5G66658, AT5G66740, AT5G66780, AT5G66800, AT5G66815, AT5G66820, AT5G66985, AT5G67020, AT5G67245, AT5G67350, AT5G67390, AT5G67410, AT5G67550, AT5G67600, AT5G67610, AT5G67620, AT5G67640, ATCG00870, ATCG01270, ATMG00010, ATMG00030, ATMG00050, ATMG00120, ATMG00130, ATMG00150, ATMG00170, ATMG00180, ATMG00200, ATMG00260, ATMG00300, ATMG00310, ATMG00320, ATMG00400, ATMG00430, ATMG00440, ATMG00450, ATMG00470, ATMG00500, ATMG00530, ATMG00540, ATMG00550, ATMG00600, ATMG00610, ATMG00620, ATMG00630, ATMG00660, ATMG00670, ATMG00680, ATMG00720, ATMG00740, ATMG00750, ATMG00760, ATMG00770, ATMG00840, ATMG00870, ATMG00880, ATMG00890, ATMG00910, ATMG00920, ATMG00970, ATMG01000, ATMG01010, ATMG01020, ATMG01030, ATMG01040, ATMG01050, ATMG01060, ATMG01090, ATMG01100, ATMG01130, ATMG01140, ATMG01150, ATMG01180, ATMG01200, ATMG01210, ATMG01220, ATMG01230, ATMG01240, ATMG01260, ATMG01290, ATMG01300, ATMG01310, ATMG01330, ATMG01350, ATMG01370, 以及 ATMG01400。对于在拟南芥中鉴定的POF, 如下POF被鉴定为对于单一物种或单一属是特异性的(本文称为ssPOF): 基因座 IDAT1G01400, AT1G01810, AT1G01990, AT1G02320, AT1G02350, AT1G02405, AT1G02450, AT1G02490, AT1G02540, AT1G02710, AT1G02965, AT1G03106, AT1G03200, AT1G03240, AT1G03320, AT1G03420, AT1G03660, AT1G04660, AT1G04670, AT1G04800, AT1G05040, AT1G05065, AT1G05085, AT1G05330, AT1G05340, AT1G05450, AT1G05490, AT1G05575, AT1G06135, AT1G06320, AT1G06420, AT1G06475, AT1G06930, AT1G07135, AT1G07190, AT1G07473, AT1G07500, AT1G07680, AT1G07690, AT1G08035, AT1G09415, AT1G10100, AT1G10420, AT1G10990, AT1G11470, AT1G11850, AT1G12080, AT1G12660, AT1G12805, AT1G12810, AT1G12845, AT1G13605, AT1G13607, AT1G13608, AT1G13609, AT1G13620, AT1G13670, AT1G13755, AT1G14755, AT1G15385, AT1G15757, AT1G15825, AT1G15830, AT1G15840, AT1G16025, AT1G16515, AT1G16730, AT1G17090, AT1G17285, AT1G17300, AT1G17510, AT1G17780, AT1G17900, AT1G18220, AT1G18510, AT1G19394, AT1G19397, AT1G19500, AT1G19620, AT1G19960, AT1G20070, AT1G20100, AT1G20280, AT1G20690, AT1G21020, AT1G21323, AT1G21395, AT1G21475, AT1G21520, AT1G21940, AT1G21950, AT1G22010, AT1G22120, AT1G22140, AT1G22335, AT1G22590, AT1G22885, AT1G22890, AT1G23050, AT1G23650, AT1G24060, AT1G24145, AT1G24390, AT1G24575, AT1G24822, AT1G24851, AT1G24938, AT1G24996, AT1G25025, AT1G25097, AT1G25112, AT1G25170, AT1G25180, AT1G25425, AT1G26140, AT1G26210, AT1G26290, AT1G26350, AT1G26710, AT1G26720, AT1G27550, AT1G27610, AT1G27640, AT1G27670, AT1G27695, AT1G27710, AT1G27790, AT1G28135, AT1G28375, AT1G28630, AT1G29010, AT1G29179, AT1G29355, AT1G29480, AT1G29530, AT1G29540, AT1G29560, AT1G29580, AT1G29610, AT1G29620, AT1G30250, AT1G30515, AT1G30757, AT1G30795, AT1G30814, AT1G30835, AT1G31060, AT1G31150, AT1G31270, AT1G31335, AT1G31520, AT1G31580, AT1G31620, AT1G31750, AT1G31772, AT1G31835, AT1G31960, AT1G31990, AT1G32000, AT1G32010, AT1G32040, AT1G32290, AT1G32337, AT1G32570, AT1G32630, AT1G32650, AT1G32670, AT1G32680, AT1G32920, AT1G32928, AT1G32975, AT1G33135, AT1G33607, AT1G33640, AT1G33820, AT1G33860, AT1G34047, AT1G34095, AT1G34280, AT1G34315, AT1G34400, AT1G34440, AT1G34590, AT1G34730, AT1G34910, AT1G35030, AT1G35040, AT1G35080, AT1G35100, AT1G35183, AT1G35230, AT1G35320, AT1G35375, AT1G35435, AT1G35500, AT1G35513, AT1G35614, AT1G35617, AT1G35

640, AT1G35820, AT1G35880, AT1G35890, AT1G35900, AT1G36100, AT1G36230, AT1G36395, AT1G36640, AT1G36670, AT1G36675, AT1G36745, AT1G36756, AT1G36763, AT1G36925, AT1G36960, AT1G36970, AT1G37000, AT1G37015, AT1G37037, AT1G37045, AT1G38380, AT1G38630, AT1G38790, AT1G38950, AT1G39350, AT1G40080, AT1G40115, AT1G40125, AT1G40129, AT1G40133, AT1G40230, AT1G41650, AT1G41750, AT1G41770, AT1G41810, AT1G41820, AT1G41855, AT1G41870, AT1G41900, AT1G42080, AT1G42190, AT1G42367, AT1G42393, AT1G42515, AT1G42580, AT1G42630, AT1G42700, AT1G42740, AT1G43205, AT1G43230, AT1G43320, AT1G43415, AT1G43720, AT1G43777, AT1G43810, AT1G43920, AT1G43940, AT1G43970, AT1G44085, AT1G44222, AT1G44740, AT1G44850, AT1G44875, AT1G44930, AT1G44990, AT1G45165, AT1G45403, AT1G46336, AT1G47280, AT1G47317, AT1G47395, AT1G47400, AT1G47485, AT1G47495, AT1G47660, AT1G47680, AT1G47690, AT1G47700, AT1G47770, AT1G47813, AT1G48145, AT1G48250, AT1G48325, AT1G48730, AT1G49110, AT1G49150, AT1G49500, AT1G49680, AT1G49715, AT1G49940, AT1G50080, AT1G50220, AT1G50290, AT1G50350, AT1G50530, AT1G50800, AT1G50930, AT1G51000, AT1G51010, AT1G51030, AT1G51430, AT1G51915, AT1G51970, AT1G52087, AT1G52090, AT1G52390, AT1G52410, AT1G52550, AT1G52615, AT1G52827, AT1G52840, AT1G52905, AT1G53265, AT1G53285, AT1G53480, AT1G53610, AT1G53620, AT1G53625, AT1G53640, AT1G53785, AT1G53935, AT1G53970, AT1G54420, AT1G54445, AT1G54575, AT1G54640, AT1G54720, AT1G54880, AT1G54923, AT1G54926, AT1G54950, AT1G55220, AT1G55330, AT1G55400, AT1G55675, AT1G55710, AT1G55990, AT1G56085, AT1G56270, AT1G56415, AT1G56530, AT1G56553, AT1G56555, AT1G56660, AT1G58055, AT1G58150, AT1G58225, AT1G58235, AT1G58242, AT1G59535, AT1G59722, AT1G59865, AT1G59885, AT1G60240, AT1G60983, AT1G60987, AT1G61090, AT1G61095, AT1G61097, AT1G61200, AT1G61688, AT1G61920, AT1G62000, AT1G62060, AT1G62070, AT1G62080, AT1G62210, AT1G62220, AT1G62225, AT1G62240, AT1G62480, AT1G62690, AT1G62935, AT1G63055, AT1G63105, AT1G63240, AT1G63522, AT1G63535, AT1G63960, AT1G64107, AT1G64360, AT1G64370, AT1G64405, AT1G64490, AT1G64560, AT1G64800, AT1G65342, AT1G65352, AT1G65490, AT1G65500, AT1G65510, AT1G65845, AT1G66145, AT1G66245, AT1G66790, AT1G66820, AT1G67350, AT1G67670, AT1G67775, AT1G67855, AT1G67860, AT1G67865, AT1G67870, AT1G68250, AT1G68430, AT1G68725, AT1G68845, AT1G68870, AT1G68875, AT1G68905, AT1G68907, AT1G68935, AT1G68945, AT1G69050, AT1G69470, AT1G69760, AT1G69825, AT1G69970, AT1G70350, AT1G70470, AT1G70895, AT1G70990, AT1G71235, AT1G71470, AT1G71910, AT1G72080, AT1G72580, AT1G72600, AT1G72645, AT1G73130, AT1G73177, AT1G73510, AT1G73603, AT1G73607, AT1G74045, AT1G74055, AT1G75190, AT1G75770, AT1G75870, AT1G76230, AT1G76820, AT1G76840, AT1G76910, AT1G76955, AT1G76960, AT1G76965, AT1G77655, AT1G77765, AT1G77885, AT1G77910, AT1G77960, AT1G78030, AT1G79170, AT1G80610, AT1G80865, AT2G01031, AT2G01175, AT2G01310, AT2G01400, AT2G02280, AT2G02440, AT2G02490, AT2G02515, AT2G02795, AT2G02835, AT2G02840, AT2G03180, AT2G03310, AT2G03320, AT2G03540, AT2G03570, AT2G03580, AT2G03830, AT2G03932, AT2G03937, AT2G04000, AT2G04025, AT2G04034, AT2G04045, AT2G04046, AT2G04063, AT2G04320, AT2G04370, AT2G04380, AT2G04410, AT2G04515, AT2G04600, AT2G04675, AT2G04800, AT2G04870, AT2G04925, AT2G05000, AT2G05117, AT2G05185, AT2G05270, AT2G05350, AT2G05500, AT2G05564, AT2G05645, AT2G05647

, AT2G05752, AT2G05915, AT2G06095, AT2G06140, AT2G06166, AT2G06230, AT2G06390, AT2G06420, AT2G06480, AT2G06555, AT2G06570, AT2G06620, AT2G06630, AT2G06645, AT2G06750, AT2G06775, AT2G06906, AT2G06908, AT2G06914, AT2G07000, AT2G07190, AT2G07215, AT2G07280, AT2G07290, AT2G07310, AT2G07505, AT2G07669, AT2G07672, AT2G07673, AT2G07674, AT2G07676, AT2G07678, AT2G07691, AT2G07692, AT2G07701, AT2G07702, AT2G07705, AT2G07706, AT2G07708, AT2G07710, AT2G07713, AT2G07719, AT2G07721, AT2G07724, AT2G07728, AT2G07738, AT2G07772, AT2G07774, AT2G07775, AT2G07776, AT2G07777, AT2G07779, AT2G07787, AT2G07795, AT2G07880, AT2G07981, AT2G08986, AT2G09388, AT2G09840, AT2G09865, AT2G09900, AT2G10020, AT2G10105, AT2G10110, AT2G10175, AT2G10285, AT2G10340, AT2G10360, AT2G10380, AT2G10390, AT2G10470, AT2G10550, AT2G10555, AT2G10602, AT2G10608, AT2G10850, AT2G10870, AT2G10920, AT2G10930, AT2G10965, AT2G10975, AT2G11005, AT2G11015, AT2G11090, AT2G11135, AT2G11370, AT2G11405, AT2G11462, AT2G11570, AT2G11620, AT2G11626, AT2G11775, AT2G11910, AT2G12110, AT2G12120, AT2G12130, AT2G12170, AT2G12320, AT2G12405, AT2G12465, AT2G12475, AT2G12505, AT2G12610, AT2G12685, AT2G12700, AT2G12875, AT2G12905, AT2G12935, AT2G12945, AT2G13125, AT2G13126, AT2G13270, AT2G13320, AT2G13430, AT2G13500, AT2G13510, AT2G13550, AT2G13660, AT2G13730, AT2G13760, AT2G13865, AT2G13975, AT2G14000, AT2G14020, AT2G14240, AT2G14247, AT2G14340, AT2G14390, AT2G14460, AT2G14590, AT2G14600, AT2G14700, AT2G14774, AT2G14800, AT2G14810, AT2G14890, AT2G14935, AT2G15185, AT2G15327, AT2G15340, AT2G15345, AT2G15420, AT2G15535, AT2G15550, AT2G15600, AT2G15800, AT2G15815, AT2G15830, AT2G15930, AT2G15960, AT2G16015, AT2G16020, AT2G16170, AT2G16340, AT2G16410, AT2G16575, AT2G16586, AT2G16676, AT2G16820, AT2G17442, AT2G17540, AT2G17723, AT2G17960, AT2G18070, AT2G18200, AT2G18270, AT2G18440, AT2G18610, AT2G18920, AT2G18930, AT2G18970, AT2G19200, AT2G19290, AT2G19300, AT2G19320, AT2G19420, AT2G19700, AT2G19802, AT2G19850, AT2G19893, AT2G20150, AT2G20208, AT2G20250, AT2G20463, AT2G20595, AT2G20620, AT2G20625, AT2G20870, AT2G20970, AT2G21185, AT2G21237, AT2G21465, AT2G21725, AT2G21780, AT2G22000, AT2G22080, AT2G22121, AT2G22122, AT2G22320, AT2G22340, AT2G22470, AT2G22510, AT2G22520, AT2G22805, AT2G22807, AT2G22820, AT2G22905, AT2G22940, AT2G22941, AT2G23040, AT2G23130, AT2G23440, AT2G23490, AT2G23920, AT2G23985, AT2G24285, AT2G24310, AT2G24340, AT2G24460, AT2G24617, AT2G24625, AT2G24780, AT2G24910, AT2G24945, AT2G25185, AT2G25250, AT2G25510, AT2G25565, AT2G25685, AT2G25990, AT2G26120, AT2G26880, AT2G27250, AT2G27315, AT2G27380, AT2G27390, AT2G27535, AT2G27540, AT2G28330, AT2G28570, AT2G28625, AT2G29045, AT2G29180, AT2G29790, AT2G29920, AT2G29995, AT2G30430, AT2G30560, AT2G30760, AT2G30925, AT2G30930, AT2G30960, AT2G30985, AT2G31035, AT2G31345, AT2G31590, AT2G31700, AT2G31751, AT2G31850, AT2G32275, AT2G32890, AT2G33233, AT2G34010, AT2G34100, AT2G34110, AT2G34120, AT2G34123, AT2G34185, AT2G34220, AT2G34230, AT2G34270, AT2G34310, AT2G34330, AT2G34655, AT2G34800, AT2G34870, AT2G35070, AT2G35080, AT2G35090, AT2G35733, AT2G35750, AT2G35870, AT2G36030, AT2G36040, AT2G36255, AT2G36440, AT2G36695, AT2G36724, AT2G36920, AT2G36940, AT2G37070, AT2G37300, AT2G37910, AT2G38350, AT2G38690, AT2G38823, AT2G39160, AT2G39520, AT2G39680, AT2G40020, AT

2G40085, AT2G40530, AT2G40765, AT2G40955, AT2G41230, AT2G41260, AT2G41280, AT2G41390, AT2G41400, AT2G41420, AT2G41440, AT2G41650, AT2G41780, AT2G41905, AT2G42050, AT2G42340, AT2G42395, AT2G42540, AT2G42860, AT2G42955, AT2G43450, AT2G44010, AT2G45403, AT2G45780, AT2G45860, AT2G45930, AT2G46360, AT2G46390, AT2G47200, AT2G47660, AT2G47720, AT2G47950, AT2G48075, AT2G48090, AT3G01230, AT3G01240, AT3G01250, AT3G01323, AT3G01325, AT3G01345, AT3G01700, AT3G01730, AT3G01960, AT3G02240, AT3G02390, AT3G02670, AT3G03020, AT3G04640, AT3G04903, AT3G04943, AT3G05080, AT3G05460, AT3G05727, AT3G05730, AT3G05935, AT3G06090, AT3G06360, AT3G06435, AT3G06545, AT3G06600, AT3G06710, AT3G06750, AT3G06870, AT3G06895, AT3G07005, AT3G07195, AT3G07568, AT3G07710, AT3G09032, AT3G09130, AT3G09162, AT3G09280, AT3G09750, AT3G09922, AT3G10116, AT3G10195, AT3G10525, AT3G10830, AT3G10930, AT3G11060, AT3G11160, AT3G11640, AT3G11745, AT3G11860, AT3G12510, AT3G12840, AT3G12977, AT3G13240, AT3G13370, AT3G13403, AT3G13435, AT3G13500, AT3G13630, AT3G13674, AT3G13845, AT3G13857, AT3G14340, AT3G14395, AT3G14480, AT3G14560, AT3G14670, AT3G15357, AT3G15400, AT3G15440, AT3G15780, AT3G15860, AT3G15910, AT3G16750, AT3G16895, AT3G17155, AT3G17190, AT3G18250, AT3G18485, AT3G18540, AT3G18700, AT3G19030, AT3G19055, AT3G19530, AT3G19790, AT3G20155, AT3G20362, AT3G20555, AT3G20850, AT3G20865, AT3G20900, AT3G21570, AT3G21680, AT3G22070, AT3G22090, AT3G22231, AT3G22235, AT3G22240, AT3G22415, AT3G23040, AT3G23165, AT3G23167, AT3G23172, AT3G23245, AT3G23295, AT3G23715, AT3G23720, AT3G23727, AT3G23850, AT3G24225, AT3G24250, AT3G24280, AT3G24380, AT3G24508, AT3G24510, AT3G24513, AT3G24517, AT3G24640, AT3G24770, AT3G25080, AT3G25200, AT3G25655, AT3G25727, AT3G25882, AT3G25905, AT3G26110, AT3G26235, AT3G26616, AT3G26800, AT3G27025, AT3G27370, AT3G27590, AT3G27800, AT3G27906, AT3G27990, AT3G28110, AT3G28120, AT3G28170, AT3G28190, AT3G28240, AT3G28260, AT3G28280, AT3G28420, AT3G28530, AT3G28590, AT3G29034, AT3G29080, AT3G29140, AT3G29210, AT3G29300, AT3G29305, AT3G29560, AT3G29570, AT3G29600, AT3G29610, AT3G29700, AT3G29786, AT3G29790, AT3G29796, AT3G30150, AT3G30160, AT3G30220, AT3G30250, AT3G30320, AT3G30350, AT3G30360, AT3G30490, AT3G30510, AT3G30520, AT3G30580, AT3G30590, AT3G30610, AT3G30645, AT3G30650, AT3G30660, AT3G30670, AT3G30690, AT3G30700, AT3G30720, AT3G30750, AT3G30751, AT3G30755, AT3G30816, AT3G30820, AT3G30840, AT3G30845, AT3G31300, AT3G31310, AT3G31320, AT3G31330, AT3G31350, AT3G31370, AT3G31400, AT3G31406, AT3G31540, AT3G31910, AT3G31915, AT3G31940, AT3G31955, AT3G32050, AT3G32070, AT3G32100, AT3G32120, AT3G32150, AT3G32160, AT3G32180, AT3G32190, AT3G32200, AT3G32896, AT3G32902, AT3G32903, AT3G32904, AT3G32960, AT3G33064, AT3G33073, AT3G33080, AT3G33131, AT3G33187, AT3G33230, AT3G33293, AT3G33393, AT3G33448, AT3G33494, AT3G33572, AT3G42070, AT3G42090, AT3G42120, AT3G42130, AT3G42140, AT3G42190, AT3G42200, AT3G42240, AT3G42254, AT3G42300, AT3G42310, AT3G42380, AT3G42390, AT3G42430, AT3G42436, AT3G42473, AT3G42480, AT3G42490, AT3G42510, AT3G42520, AT3G42540, AT3G42556, AT3G42590, AT3G42610, AT3G42680, AT3G42700, AT3G42723, AT3G42740, AT3G42750, AT3G42780, AT3G42786, AT3G42810, AT3G42870, AT3G42920, AT3G42970, AT3G42990, AT3G43140, AT3G43150, AT3G43153, AT3G43160, AT3G43280, AT3G43290, AT3G4

3410, AT3G43420, AT3G43450, AT3G43470, AT3G43480, AT3G43500, AT3G43528, AT3G43580, AT3G43583, AT3G43680, AT3G43682, AT3G43833, AT3G43863, AT3G43870, AT3G43880, AT3G43940, AT3G43970, AT3G44040, AT3G44070, AT3G44140, AT3G44170, AT3G44210, AT3G44230, AT3G44235, AT3G44430, AT3G44440, AT3G44470, AT3G44570, AT3G44580, AT3G44690, AT3G44755, AT3G44760, AT3G44770, AT3G44935, AT3G44950, AT3G44980, AT3G45093, AT3G45110, AT3G45120, AT3G45160, AT3G45230, AT3G45320, AT3G45360, AT3G45370, AT3G45443, AT3G45730, AT3G45820, AT3G45910, AT3G46150, AT3G46360, AT3G46380, AT3G46390, AT3G47100, AT3G47230, AT3G47240, AT3G47295, AT3G47320, AT3G47410, AT3G47510, AT3G47836, AT3G47920, AT3G47965, AT3G48185, AT3G48231, AT3G48640, AT3G49230, AT3G49270, AT3G49300, AT3G49305, AT3G49307, AT3G49540, AT3G49770, AT3G49820, AT3G50250, AT3G50320, AT3G50373, AT3G50540, AT3G50550, AT3G50570, AT3G50580, AT3G50925, AT3G52550, AT3G52700, AT3G53235, AT3G54520, AT3G54530, AT3G54730, AT3G55790, AT3G55860, AT3G55910, AT3G56260, AT3G56390, AT3G56610, AT3G56670, AT3G56910, AT3G57110, AT3G57160, AT3G57210, AT3G57690, AT3G57850, AT3G58080, AT3G58230, AT3G58280, AT3G58300, AT3G58330, AT3G58540, AT3G58770, AT3G58870, AT3G59370, AT3G59460, AT3G59880, AT3G59930, AT3G60560, AT3G60760, AT3G60890, AT3G60930, AT3G61898, AT3G62350, AT3G62400, AT3G62480, AT3G62490, AT3G62990, AT3G63040, AT3G63050, AT3G63100, AT3G63160, AT4G00280, AT4G00890, AT4G00930, AT4G01340, AT4G01525, AT4G01535, AT4G01735, AT4G01895, AT4G01915, AT4G01985, AT4G02000, AT4G02160, AT4G02465, AT4G03165, AT4G03305, AT4G03505, AT4G03580, AT4G03680, AT4G03740, AT4G03750, AT4G03940, AT4G03970, AT4G03975, AT4G03979, AT4G04155, AT4G04273, AT4G04394, AT4G04396, AT4G04398, AT4G04423, AT4G04525, AT4G04730, AT4G04820, AT4G04925, AT4G05290, AT4G05523, AT4G05553, AT4G05560, AT4G05580, AT4G05581, AT4G05616, AT4G05631, AT4G05632, AT4G05636, AT4G05640, AT4G06490, AT4G06603, AT4G06637, AT4G06672, AT4G06716, AT4G06724, AT4G06728, AT4G06735, AT4G06740, AT4G07380, AT4G07452, AT4G07460, AT4G07485, AT4G07500, AT4G07523, AT4G07526, AT4G07666, AT4G07675, AT4G07740, AT4G07825, AT4G07868, AT4G07932, AT4G07943, AT4G07965, AT4G08028, AT4G08039, AT4G08097, AT4G08098, AT4G08111, AT4G08130, AT4G08270, AT4G08336, AT4G08395, AT4G08485, AT4G08555, AT4G08593, AT4G08602, AT4G08710, AT4G08730, AT4G08740, AT4G08760, AT4G08868, AT4G08869, AT4G08874, AT4G08875, AT4G09030, AT4G09153, AT4G09210, AT4G09220, AT4G09260, AT4G09270, AT4G09290, AT4G09390, AT4G09647, AT4G09840, AT4G09850, AT4G09860, AT4G09880, AT4G09984, AT4G10820, AT4G10845, AT4G10860, AT4G10870, AT4G11020, AT4G11100, AT4G11385, AT4G11393, AT4G11700, AT4G11870, AT4G11940, AT4G12005, AT4G12220, AT4G12380, AT4G12580, AT4G12735, AT4G12930, AT4G12940, AT4G12990, AT4G13095, AT4G13150, AT4G13195, AT4G13235, AT4G13320, AT4G13470, AT4G13955, AT4G13968, AT4G14104, AT4G14120, AT4G14315, AT4G14530, AT4G14650, AT4G14810, AT4G15096, AT4G15150, AT4G15460, AT4G15563, AT4G15650, AT4G15710, AT4G15733, AT4G15735, AT4G15950, AT4G15990, AT4G16000, AT4G16040, AT4G16090, AT4G16140, AT4G16215, AT4G16240, AT4G16447, AT4G16460, AT4G16515, AT4G16840, AT4G16980, AT4G17700, AT4G17713, AT4G17930, AT4G17990, AT4G18000, AT4G18080, AT4G18090, AT4G18280, AT4G18310, AT4G18395, AT4G18420, AT4G18490, AT4G18500, AT4G18501, AT4G18510, AT4G18580, AT4G1882

3, AT4G18850, AT4G18860, AT4G19095, AT4G19200, AT4G19240, AT4G19270, AT4G19280, AT4G19290, AT4G19305, AT4G19320, AT4G19480, AT4G19620, AT4G19905, AT4G20095, AT4G20250, AT4G20290, AT4G20470, AT4G20500, AT4G20510, AT4G20690, AT4G20715, AT4G21215, AT4G21865, AT4G21920, AT4G21950, AT4G22210, AT4G22214, AT4G22217, AT4G22235, AT4G22420, AT4G22430, AT4G22440, AT4G22510, AT4G22800, AT4G23090, AT4G23110, AT4G23493, AT4G23760, AT4G23770, AT4G23780, AT4G23870, AT4G23970, AT4G24030, AT4G24275, AT4G24300, AT4G24410, AT4G24600, AT4G24950, AT4G25510, AT4G26030, AT4G26040, AT4G26290, AT4G26320, AT4G26960, AT4G27415, AT4G27530, AT4G27580, AT4G27652, AT4G27654, AT4G27657, AT4G27850, AT4G27930, AT4G28085, AT4G28160, AT4G28180, AT4G28460, AT4G28810, AT4G28870, AT4G28920, AT4G28930, AT4G29020, AT4G29030, AT4G29200, AT4G29273, AT4G29280, AT4G29285, AT4G29290, AT4G29300, AT4G29305, AT4G30050, AT4G30064, AT4G30450, AT4G30460, AT4G30662, AT4G30670, AT4G30730, AT4G30750, AT4G30970, AT4G31030, AT4G31260, AT4G31280, AT4G31875, AT4G31960, AT4G32080, AT4G32230, AT4G32240, AT4G33310, AT4G33560, AT4G33610, AT4G33660, AT4G33666, AT4G33750, AT4G33960, AT4G34690, AT4G35170, AT4G35400, AT4G35430, AT4G35725, AT4G36170, AT4G36370, AT4G36460, AT4G36510, AT4G36515, AT4G36560, AT4G36925, AT4G37295, AT4G37450, AT4G37685, AT4G38080, AT4G38330, AT4G38820, AT4G39320, AT4G39360, AT4G39403, AT4G39675, AT4G39745, AT4G39917, AT4G39930, AT4G40090, AT5G01080, AT5G01881, AT5G02000, AT5G02520, AT5G02550, AT5G02650, AT5G02690, AT5G03060, AT5G03090, AT5G03130, AT5G03210, AT5G03400, AT5G03545, AT5G03550, AT5G03710, AT5G03920, AT5G03930, AT5G03950, AT5G04030, AT5G04045, AT5G04470, AT5G04650, AT5G04790, AT5G05020, AT5G05640, AT5G05965, AT5G06043, AT5G06190, AT5G06380, AT5G06980, AT5G07730, AT5G08090, AT5G08150, AT5G08185, AT5G08210, AT5G08220, AT5G08505, AT5G09480, AT5G09520, AT5G09980, AT5G09990, AT5G10040, AT5G10430, AT5G10590, AT5G10670, AT5G10745, AT5G11120, AT5G11830, AT5G11990, AT5G12880, AT5G12990, AT5G13825, AT5G14330, AT5G14380, AT5G14560, AT5G14730, AT5G15000, AT5G15190, AT5G15360, AT5G15420, AT5G15560, AT5G15725, AT5G15960, AT5G15970, AT5G15990, AT5G17130, AT5G17340, AT5G17360, AT5G17590, AT5G17650, AT5G18403, AT5G18407, AT5G18690, AT5G19172, AT5G19800, AT5G19810, AT5G20460, AT5G20760, AT5G20770, AT5G21020, AT5G21110, AT5G21125, AT5G21910, AT5G22150, AT5G22160, AT5G22170, AT5G22180, AT5G22190, AT5G22520, AT5G22530, AT5G22545, AT5G22555, AT5G22680, AT5G22970, AT5G23035, AT5G23180, AT5G23212, AT5G23460, AT5G23640, AT5G24250, AT5G24313, AT5G24316, AT5G24480, AT5G24570, AT5G24590, AT5G25000, AT5G25210, AT5G25425, AT5G25600, AT5G25750, AT5G25870, AT5G25920, AT5G26020, AT5G26070, AT5G26080, AT5G26100, AT5G26270, AT5G26350, AT5G26622, AT5G26692, AT5G26717, AT5G26720, AT5G26800, AT5G26840, AT5G26890, AT5G26970, AT5G27170, AT5G27180, AT5G27340, AT5G27440, AT5G27500, AT5G27590, AT5G27606, AT5G27800, AT5G27890, AT5G28070, AT5G28090, AT5G28110, AT5G28120, AT5G28130, AT5G28140, AT5G28170, AT5G28190, AT5G28240, AT5G28270, AT5G28295, AT5G28410, AT5G28430, AT5G28463, AT5G28480, AT5G28482, AT5G28484, AT5G28560, AT5G28600, AT5G28610, AT5G28620, AT5G28623, AT5G28630, AT5G28720, AT5G28785, AT5G28790, AT5G28800, AT5G28810, AT5G28820, AT5G28860, AT5G28920, AT5G28990, AT5G29020, AT5G29050, AT5G29070, AT5G29090, AT

5G29210, AT5G29576, AT5G29602, AT5G29613, AT5G30341, AT5G30520, AT5G31685, AT5G31752, AT5G31753, AT5G31787, AT5G31838, AT5G31873, AT5G32161, AT5G32169, AT5G32312, AT5G32405, AT5G32410, AT5G32590, AT5G32600, AT5G32605, AT5G32610, AT5G32619, AT5G32775, AT5G33230, AT5G33355, AT5G33380, AT5G33390, AT5G33393, AT5G33715, AT5G33806, AT5G33898, AT5G34358, AT5G34450, AT5G34581, AT5G34820, AT5G34830, AT5G34910, AT5G34970, AT5G34980, AT5G35010, AT5G35020, AT5G35035, AT5G35090, AT5G35195, AT5G35230, AT5G35270, AT5G35290, AT5G35300, AT5G35470, AT5G35480, AT5G35490, AT5G35510, AT5G35540, AT5G35603, AT5G35604, AT5G35646, AT5G35737, AT5G35760, AT5G35792, AT5G35880, AT5G35890, AT5G35945, AT5G36020, AT5G36035, AT5G36040, AT5G36060, AT5G36070, AT5G36080, AT5G36190, AT5G36650, AT5G36720, AT5G36735, AT5G36900, AT5G36920, AT5G36925, AT5G36960, AT5G37120, AT5G37240, AT5G37385, AT5G37473, AT5G37474, AT5G37880, AT5G38080, AT5G38090, AT5G38190, AT5G38310, AT5G38400, AT5G38595, AT5G38790, AT5G38980, AT5G39140, AT5G39170, AT5G39205, AT5G39365, AT5G39570, AT5G39880, AT5G40070, AT5G40110, AT5G40155, AT5G40180, AT5G40595, AT5G40620, AT5G40730, AT5G40855, AT5G41320, AT5G41640, AT5G41660, AT5G42110, AT5G42146, AT5G42223, AT5G42232, AT5G42235, AT5G42242, AT5G42530, AT5G42635, AT5G42797, AT5G42825, AT5G43000, AT5G43185, AT5G43285, AT5G43401, AT5G43405, AT5G43480, AT5G43510, AT5G43513, AT5G43770, AT5G44005, AT5G44313, AT5G44565, AT5G44570, AT5G44575, AT5G44580, AT5G44880, AT5G44973, AT5G45573, AT5G46115, AT5G46120, AT5G46300, AT5G46310, AT5G46320, AT5G46500, AT5G46730, AT5G46770, AT5G46871, AT5G46873, AT5G46874, AT5G46877, AT5G47170, AT5G48175, AT5G48200, AT5G48280, AT5G48420, AT5G48515, AT5G48530, AT5G48595, AT5G48605, AT5G48657, AT5G48860, AT5G48953, AT5G49015, AT5G49090, AT5G49250, AT5G49260, AT5G49280, AT5G49440, AT5G49590, AT5G49640, AT5G49790, AT5G50190, AT5G50335, AT5G50500, AT5G50540, AT5G50565, AT5G50610, AT5G50645, AT5G50665, AT5G50710, AT5G50880, AT5G50910, AT5G51090, AT5G51105, AT5G51195, AT5G51390, AT5G51580, AT5G51650, AT5G51845, AT5G52080, AT5G52130, AT5G52547, AT5G52965, AT5G53410, AT5G53740, AT5G53895, AT5G53905, AT5G53960, AT5G54067, AT5G54095, AT5G54145, AT5G54215, AT5G54350, AT5G54410, AT5G54460, AT5G54585, AT5G54790, AT5G54970, AT5G55010, AT5G55131, AT5G55132, AT5G55135, AT5G55420, AT5G55430, AT5G55507, AT5G55650, AT5G55680, AT5G55750, AT5G55790, AT5G55870, AT5G55893, AT5G56100, AT5G56368, AT5G56369, AT5G56795, AT5G56880, AT5G57310, AT5G57400, AT5G57650, AT5G57730, AT5G57760, AT5G57790, AT5G57887, AT5G58570, AT5G58650, AT5G59060, AT5G59105, AT5G59170, AT5G59330, AT5G59360, AT5G60000, AT5G60240, AT5G60260, AT5G60290, AT5G60330, AT5G60350, AT5G60400, AT5G60553, AT5G60650, AT5G60805, AT5G60810, AT5G61110, AT5G61120, AT5G61360, AT5G61605, AT5G61660, AT5G61710, AT5G62330, AT5G62400, AT5G62623, AT5G62627, AT5G62750, AT5G63340, AT5G63720, AT5G63820, AT5G63905, AT5G64540, AT5G64690, AT5G64770, AT5G64800, AT5G64890, AT5G64900, AT5G64905, AT5G65300, AT5G65390, AT5G65495, AT5G65580, AT5G65610, AT5G65880, AT5G65925, AT5G66000, AT5G66052, AT5G66340, AT5G66658, AT5G66985, AT5G67245, AT5G67350, AT5G67600, AT5G67640, ATCG00870, ATCG01270, ATMG00030, ATMG00050, ATMG00120, ATMG00130, ATMG00150, ATMG00200, ATMG00260, ATMG00320, ATMG00400, ATMG00430, ATMG00440, ATMG00450, ATMG0

0470, ATMG00500, ATMG00530, ATMG00540, ATMG00600, ATMG00610, ATMG00630, ATMG00670, ATMG00680, ATMG00720, ATMG00740, ATMG00760, ATMG00770, ATMG00840, ATMG00870, ATMG00880, ATMG00890, ATMG00920, ATMG00970, ATMG01000, ATMG01010, ATMG01020, ATMG01030, ATMG01040, ATMG01050, ATMG01060, ATMG01090, ATMG01100, ATMG01130, ATMG01140, ATMG01150, ATMG01180, ATMG01200, ATMG01210, ATMG01230, ATMG01240, ATMG01260, ATMG01290, ATMG01300, ATMG01310, ATMG01350, ATMG01370, 及 ATMG01400。可以分析(例如敲除突变,过表达等)这些 POF 改变在发现其的植物物种(即对于上述鉴别的 POF 的拟南芥)中的至少一种生物化学成分的量的能力。在已经确定 POF 可改变在之中发现其的植物物种中至少一种生物化学成分的量之后,所述 POF 可以导入(例如根据本文所述及本领域已知的方法)另一植物物种中,其优选来自另一属并且其 WT 不含有所述 POF,分析其在该植物物种中改变至少一种生物化学成分的量。当使用 NCBI BLAST 程序利用蛋白质查询检索蛋白质数据库时,使用 compositional matrix adjust 方法确定,QQS 对其本身仅具有 $4e^{-29}$ 的预期值。

实施例

[0042] 如下实施例是为了例证本发明。所述实施例不限制本发明的范围。

[0043] 实施例 1

[0044] 本实施例描述在除拟南芥属之外的植物中表达 QQS 的载体的构建。

[0045] 35S::QQS 融合构建体通过将扩增的全长编码序列克隆进图 3 所示二元载体 pB2GW7 中而制备。QQS 在 35S 启动子控制下表达。将 35S::QQS-pB2GW7 载体转化进根癌土壤杆菌菌株 EHA101 中。

[0046] 实施例 2

[0047] 本实施例描述表达 QQS 的转基因大豆品系的转化和选择。

[0048] 通过农杆菌介导的转化技术使用半种外植体 (half-seed explants) 方法 (Paz et al., Euphytica 136:167-179 (2004)) 转化栽培品种 Williams82。R1 植物的转化和选择在位于爱荷华州立大学的 Plant Transformation Facility 中进行。基于 Bar 抗性选择来自独立转化的大豆植物。

[0049] 实施例 3

[0050] 本实施例描述与 WT 大豆相比的表达 QQS 的大豆叶的淀粉含量分析。

[0051] 表达 QQS 的转基因大豆品系 (ST94-32#1, ST94-32#2 和 ST94-16#1) 和 WT 大豆品系 (Williams82) 在 27°C、16 小时光照和 20°C、8 小时黑暗的受控环境条件下在生长箱中生长于花盆中,每盆 3 个植株。花盆随机放置在生长箱中。

[0052] 集合来自三个个体植株的顶节的叶 (500 - 1,000mg 鲜重),在 50mL 80%

[0053] 54

[0054] (v/v) 乙醇中煮沸。然后将煮沸的叶用研杵在 80% 乙醇中研磨,在 13,000rpm 离心 10 分钟。所得沉淀用 80% 乙醇洗涤两次。在洗涤后,将不溶材料悬浮于 10mL 蒸馏水中,煮沸 30 分钟。使用淀粉葡萄糖苷酶和 Megazyme's GOPOD 格式 (Megazyme International Ireland Ltd., Wicklow, Ireland),对每个叶样品中的总淀粉 (D-葡萄糖) 进行定量。这个分析进行一式三份。结果示于表 1 和图 2。

[0055] 实施例 4

[0056] 本实施例描述与 WT 大豆相比的表达 QQS 的大豆种子的油、蛋白和水分含量的分析。

[0057] 种子的油、蛋白和水分含量用 Minispec-mq-one (BRUKER Optics Inc., The Woodlands, TX) 经核磁共振 (NMR) 测量。种子被置于 10mm 玻璃试管中并称重。试管置于 Minispec-mq-one 中并遵照屏幕指示。Minispec-mq-one 提供的软件计算油、蛋白和水分的百分比。数据从鲜重转化为干重。结果示于表 1 和图 2。

[0058] 实施例 5

[0059] 本实施例描述与 WT 大豆相比的表达 QQS 的大豆叶的总 RNA 分析。

[0060] 用 TRIzol RNA 分离方法从实施例 1 的集合叶样品提取总 RNA。总 RNA 用 QIAGEN RNeasy Mini Kit (QIAGEN, Valencia, CA) 纯化。

[0061] 1 微克总 RNA 用 200ng 随机六聚体 (Invitrogen, Paisley, UK) 和 Superscript II 逆转录酶 (Invitrogen) 根据厂商指导进行逆转录。cDNA 在 4°C 储存直至用聚合酶链反应 (PCR) 扩增。

[0062] 用于 QQS 的特异引物和荧光探针购自 Applied Biosystems (At03403756_sH UBQ10; Warrington, UK), 用于 PCR 中。18S 核糖体 RNA (18S rRNA) 对照试剂 (Applied Biosystems) 用作内源对照以对每个样品中的总 RNA 量的差异进行标准化及用于 RNA 质量控制 (Zhong et al., Biochem. Biophys. Res. Comm. 259:523-526 (1999); Schmit tgen et al., J. Biochem. Biophys. Meth. 46:69-81 (2000); 和 Bhatia et al., Anal. Biochem. 216:223-226 (1994))。PCR 反应用 7500Fast Real-Time PCR System (Applied Biosystems) 进行。如厂商推荐, 每个反应在 25 μ l 中进行并且含有 5ng 逆转录的 RNA 当量 (1ng RNA 用于 18S 分析)、50% TaqMan2X PCR Master Mix (PE Applied Biosystems) 和 1.25 μ l 引物 / 探针混合物。PCR 反应条件是 95°C、10 分钟, 然后 40 个循环, 每个循环由 95°C、15 秒以及 60°C、1 分钟组成。

[0063] 样品内的相对 RNA 水平通过使用来自一个样品的 cDNA 及制备覆盖相当于 100ng-3.125ng 总 RNA 的范围的 2 倍系列稀释液 (对于 18S rRNA 分析, 范围是 4ng-0.125ng) 而产生 PCR 反应的标准曲线而确定。样品用 Applied Biosystems 描述的标准曲线方法分析。显示相对于中位 18S rRNA Ct 值超过 2 个循环阈值 (Ct) 差异的那些样品被排除, 从而表达谱不变形。结果示于表 1。

[0064] 表 1

[0065]

样品	QQS/18S rRNA (经 RT-PCR)	淀粉 (mg/g 鲜重; % 降低)	油 (% 干重; % 降低)	蛋白质 (% 干重; % 增加)	鲜重 (平均每个 种子克数)
QQS-Williams 82 #1	81.78	4.64*; 70.18%	19.05*; 5.00%	51.24**; 60.63%	0.162
QQS-Williams 82 #2	4.57	2.71*; 82.58%	16.76**; 16.41%	42.31**; 32.63%	0.161
QQS-Williams 82 #11	15.81	7.51*; 51.74%	17.39**; 13.27%	46.92**; 47.08%	0.156
Williams 82	0.00	15.56	20.05	31.9	0.159

[0066] *Student' s t- 检验, P<0.05

[0067] **Student' s t- 检验, P<0.01

[0068] 如表 1 和图 2 所示, 表达 QQS 的大豆品系的叶淀粉含量显著低于 WT 大豆 (Williams82) 的叶淀粉含量。表达 QQS 的大豆的种子的油含量也低于 WT 大豆种子的油含量。但是, 与叶淀粉含量和种子的油含量截然相反, 表达 QQS 的大豆种子的蛋白含量显著高于 WT 大豆的种子的蛋白含量。

[0069] 实施例 6

[0070] 本实施例描述生长在生长箱、温室或者田地中的表达 QQS 的大豆种子与 WT 大豆相比的油、蛋白和水分含量的分析。

[0071] 表达 QQS 的转基因大豆品系 (ST94-32#1, ST94-32#2 和 ST94-16#1) 和 WT 大豆品系 (Williams82) 在 27℃、16 小时光照和 20℃、8 小时黑暗的受控环境条件下在生长箱中生长于花盆中, 每盆 3 个植株。花盆随机放置在生长箱中。

[0072] 表达 QQS 的转基因大豆品系 (ST94-32#1, ST94-32#2 和 ST94-16#1) 和 WT 大豆品系 (Williams82) 在 27℃、16 小时光照和 20℃、8 小时黑暗的受控环境条件下在温室中生长于花盆中, 每盆 3 个植株。花盆随机放置在温室中。

[0073] 表达 QQS 的转基因大豆品系 (ST94-32#1, ST94-32#2 和 ST94-16#1) 和 WT 大豆品系 (Williams82) 生长于 Ames, IA 的田地中。种植 5 份重复, 每份含有一列每个品系。

[0074] 种子的油、蛋白和水分含量通过近红外光谱学 (NIRS) 测量。数据调整至水分含量为 10.97%。数据示于表 2-4。如表 2 所示, 在生长于生长箱中的表达 QQS 的突变大豆植物中蛋白质增加 (直至 16.85%), 油和纤维降低。如表 3 所示, 在生长于温室中的表达 QQS 的突变大豆植物中蛋白质增加 (直至 13.5%), 油、纤维和碳水化合物降低。如表 4 所示, 在生长于田地中的表达 QQS 的突变大豆植物中蛋白质增加 (直至 9.5%), 油、纤维和碳水化合物降低。

[0075] 表 2: R2 种子的生长箱数据 (2010 年)

[0076]

		平均值					变化 (% WT)					QQS 转录物 ⁺	叶淀粉 [^]
		水分 (%)	蛋白质*	油*	纤维*	P+O*	蛋白质	油	纤维	P+O			
QQS-Williams #1	82	7.83	38.47	18.49	4.88	56.96	9.93	-5.25	-4.72	4.49	81.7844	4.6401	
QQS-Williams #2	82	6.57	39.33	18.18	4.81	57.51	12.37	-6.81	-6.06	5.51	5.11354	5.2615	
QQS-Williams #3	82	5.93	40.90	17.57	4.78	58.47	16.85	-9.96	-6.72	7.26	2.73198	13.638	
QQS-Williams #4	82	6.93	37.90	18.73	4.81	56.62	8.28	-4.01	-6.06	3.88	45.3269	14.94	
QQS-Williams #5	82	5.97	37.56	18.73	4.88	56.28	7.30	-4.01	-4.73	3.25	4.57207	2.7128	
QQS-Williams #6	82	6.40	39.54	17.98	4.74	57.51	12.96	-7.86	-7.39	5.51	2.62104	5.7704	
QQS-Williams #7	82	7.50	38.89	18.32	4.78	57.20	11.11	-6.11	-6.73	4.94	2.87029	11.014	
QQS-Williams #8	82	10.97	40.01	19.07	4.57	59.08	14.32	-2.27	-10.72	8.38	2.19775	5.6369	
Williams 82		6.73	35.00	19.51	5.12	54.51	0.00	0.00	0.00	0.00	0	15.561	

[0077] * 示出的平均蛋白质、油、纤维和 P+O (蛋白质和油) 的数据是基于干重的 %

[0078] ⁺ 示出的 QQS 转录物的数据是基于 QQS/18S rRNA

[0079] [^] 示出的叶淀粉的数据是基于 mg/g 鲜重

[0080] 表 3: R2 种子的温室数据 (2011 年)

[0081] * 示出的平均蛋白质、油、纤维、CHO (碳水化合物) 和 P+O (蛋白质和油) 的数据是基于干重的 %

[0082] ⁺ 示出的 QQS 转录物的数据是基于 QQS/18S rRNA

[0083] [^] 示出的叶淀粉的数据是基于 mg/g 鲜重

[0084] 表 4: R2/R3 种子的田地数据 (2011 年)

[0085]

	平均值						变化 (% WT)					QQS 转录物 ⁺	叶淀粉 [^]
	水分 (%)	蛋白质*	油*	纤维*	CHO*	P+O*	蛋白质	油	纤维	CHO	P+O		
QQS-Williams	8.5	35.99	17.91	5.15	24.87	53.90	3.33	-0.57	-1.95	-3.70	2.00	81.78443	4.64013

[0086]

82 #1														
QQS-Williams	9.7	36.98	17.19	5.08	24.66	54.17	6.17	-4.55	-3.25	-4.49	2.52	2.621037	5.77036	
82 #6														
QQS-Williams	7.0	35.78	17.91	5.12	25.11	53.69	2.74	-0.57	-2.60	-2.77	1.61	2.870293	11.014	
82 #7														
QQS-Williams	7.3	38.17	16.20	5.05	24.49	54.37	9.50	-10.23	-3.90	-4.89	2.78	0.031645	8.73995	
82 #9														
Williams 82	7	34.83	18.01	5.25	25.82	52.84	0.00	0.00	0.00	0.00	0.00	0	15.5605	

[0087] * 示出的平均蛋白质、油、纤维、CHO（碳水化合物）和 P+O（蛋白质和油）的数据是基于干重的 %

[0088] + 示出的 QQS 转录物的数据是基于 QQS/18S rRNA

[0089] ^ 示出的叶淀粉的数据是基于 mg/g 鲜重

[0090] 尽管在所有条件下蛋白质含量和总蛋白质 + 油含量增加，但是在生长箱 / 温室条件下蛋白质含量和总蛋白质 + 油含量的增加比田地条件下的增加更高。这些差异可能反映了生长箱和温室中的土壤补加了肥料（即 Miracle Gro Excel 15-5-15），而田地中的土壤没有。这个研究将在所有生长条件下补加土壤而重复。

[0091] 本文引用的所有参考文献，包括出版物、专利申请和专利援引加入本文，就像每个参考文献单独特异被示出援引加入本文并且在本文中全文示出。

[0092] 术语“一个”、“所述”及类似指代在描述本发明上下文（特别是在下述权利要求书上下文）中是指包括单数和复数，除非在本文中另有说明或上下文清楚指示不是这样。本文中数值范围的引用仅仅是各个引用所述范围内每个分离数值的简便方法，除非本文另外指明，并且每个分离数值并入本发明说明书，就像其在本文中单独引用一样。本文描述的所有方法可以任何合适次序进行，除非本文另有说明或者上下文清楚指示不是这样。

[0093] 任何和所有实施例或者本文提供的示例性语言（例如“如”）仅是更好阐明本发明，不是限制本发明范围，除非另有声明。本发明中的语言不应解释为表明任何没有请求保护的元件对于实施本发明是必需的。

[0094] 本文描述了本发明的优选实施方案，包括发明人已知的进行本发明的最佳模式。应理解示出的实施方案仅是举例性的，不应是限制本发明范围。

[0001]

序列表

<110> 衣阿华州立大学研究基金公司

<120> 改变植物中生物化学成分的材料和方法

<130> ISURF 1101PCT

<150> 61/446460

<151> 2011-02-24

<160> 2

<170> PatentIn version 3.5

<210> 1

<211> 586

<212> DNA

<213> Arabidopsis thaliana QQS

<400> 1

```

ctcagaagaa gcctccttgc gatctgtcag ccattgaaga aacctccttt cgatctgtca      60
gccattgaag atcagaagaa acaagactca caeggtcagc cattgaagaa gctcctctctc      120
attacctctc atcaaacatc tagatctgta cccaaacctt atcccttttt ccttattttct      180
cgctttgtct attettaate tgattaatac ttgtttgtgt tccaggttat agaagatctg      240
ggtttgtgta tatgcttcat ttctecaca ggcaccagtt ggtgtttggt tcttagattc      300
atgaagacca atagagagca gaaattttac gttgaaagaa gcttcaaacc aaacaattca      360
acaattcaga atttgatgga cattgaaagg ttcattttgc ctcacactic tacatcaggt      420
gtcgcaaggc tcaaaatgag ggtcatatca tgggtcgggc ttcagtteta caactactga      480
tattgggect tatcacaaat tagttatagg gccattgtat ccaatattta atatctctgt      540
aaacttgitt aatggttatt ttgttetaat gccattaca actaga                          586
    
```

<210> 2

<211> 59

<212> PRT

<213> Arabidopsis thaliana QQS

<400> 2

```

Met Lys Thr Asn Arg Glu Gln Glu Ile Tyr Val Glu Arg Ser Phe Lys
 1          5          10          15
Pro Asn Asn Ser Thr Ile Gln Asn Leu Met Asp Ile Glu Arg Phe Ile
          20          25          30
Leu Pro His Thr Ser Thr Ser Gly Val Ala Arg Leu Lys Met Arg Val
          35          40          45
Ile Ser Trp Val Gly Leu Gln Phe Tyr Asn Tyr
          50          55
    
```

```

1  ctcagaagaa gctcctttc gatctgtcag ccattgaaga aacctccttt cgatctgtca
61  gccattgaag atcagaagaa acaagactca caoggtcagc cattgaagaa gctcctctc
121 attacctctc atcaaacatc tagatctgta cccaaacctt atcccttttt ccttatttct
181 cgotttgtot attcttaatc tgattaatac ttgttgttgt tccaggttat agaagatctg
241 ggttgtgta tatgcttcat ttctccaca gogaccagtt ggtgtttggt ttttagattc
301 atgaagacca atagagagca gaaatttac gttgaaagaa gcttcaaacc aaacaattca
361 acaattcaga atttgatgga cattgaaagg ttcattttgc ctcacacttc tacatcaggt
421 gtgcgaaggc tcaaaatgag ggtcatatca tgggtcgggc ttcagttcta caactactga
481 tattgggcct tatcacaatc tagttatagg gccattgtat ccaatattta atatctctgt
541 aaacttgttt aatggttatt ttgttctaact gccattaca actaga [SEQ ID NO: 1]
    
```

图 1a

```

MKTNREQEILYVERSFKPNNSTIQNLMDIERFILPHTSTSGVARLKMVRVISWVGLQFYNY [SEQ ID NO: 2]
    
```

图 1b

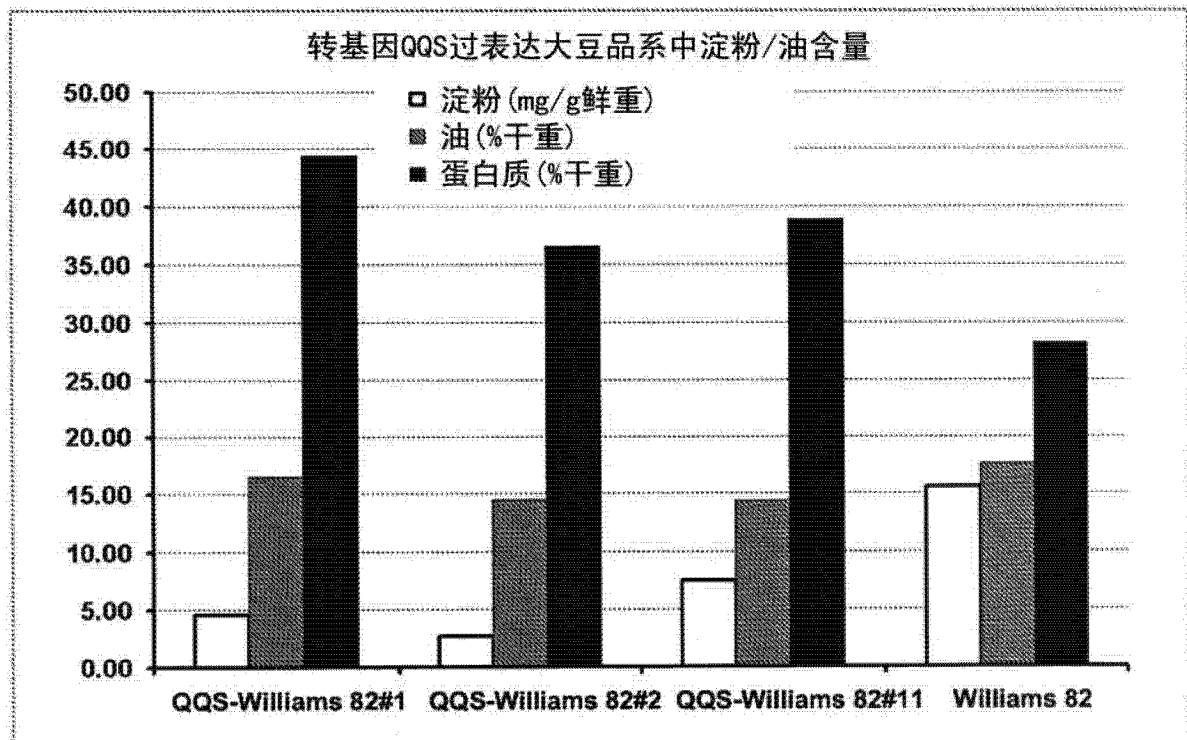


图 2

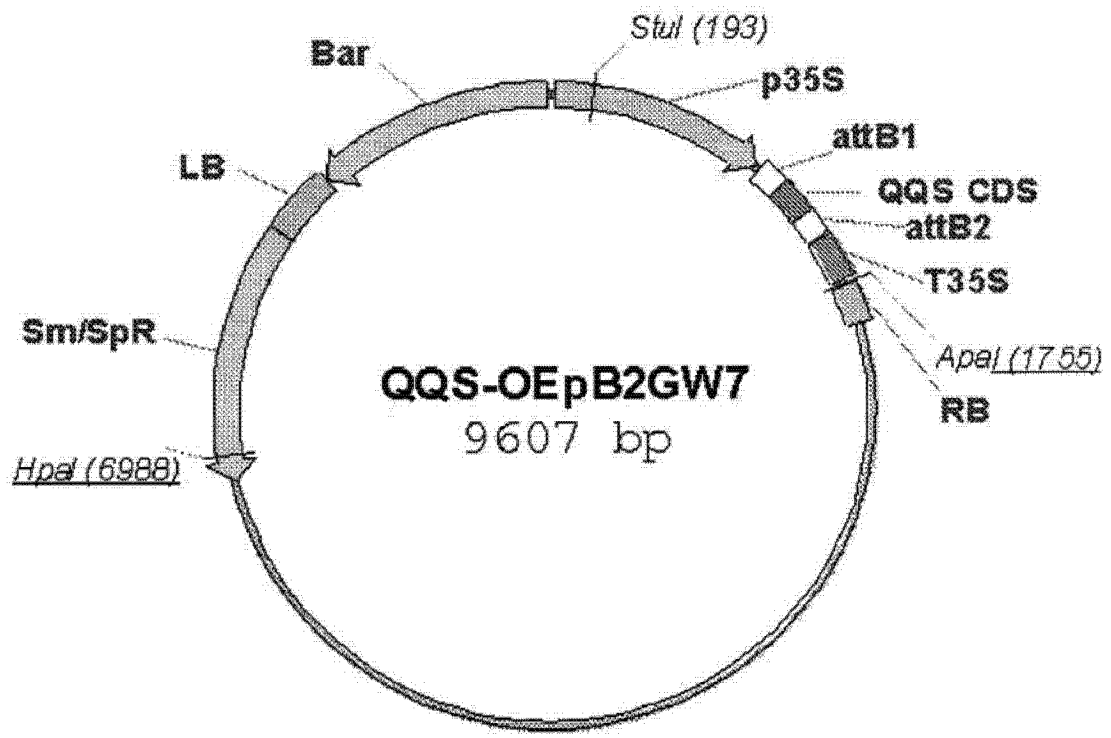


图 3