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# Development of Genomic Microsatellite Multiplex PCR Using Dye-Labeled Universal Primer and Its Validation in Pedigree Analysis of Pacific Oyster (*Crassostrea gigas*)

LIU Ting, LI Qi<sup>\*</sup>, SONG Junlin, and YU Hong

Key Laboratory of Mariculture of Ministry of Education, Ocean University of China, Qingdao 266003, P. R. China

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**Abstract** There is an increasing requirement for traceability of aquaculture products, both for consumer protection and for food safety. There are high error rates in the conventional traceability systems depending on physical labels. Genetic traceability technique depending on DNA-based tracking system can overcome this problem. Genealogy information is essential for genetic traceability, and microsatellite DNA marker is a good choice for pedigree analysis. As increasing genotyping throughput of microsatellites, microsatellite multiplex PCR has become a fast and cost-effective technique. As a commercially important cultured aquatic species, Pacific oyster *Crassostrea gigas* has the highest global production. The objective of this study was to develop microsatellite multiplex PCR panels with dye-labeled universal primer for pedigree analysis in *C. gigas*, and these multiplex PCRs were validated using 12 full-sib families with known pedigrees. Here we developed six informative multiplex PCRs using 18 genomic microsatellites in *C. gigas*. Each multiplex panel contained a single universal primer M13(-21) used as a tail on each locus-specific forward primer and a single universal primer M13(-21) labeled with fluorophores. The polymorphisms of the markers were moderate, with an average of 10.3 alleles per locus and average polymorphic information content of 0.740. The observed heterozygosity per locus ranged from 0.492 to 0.822. Cervus simulations revealed that the six panels would still be of great value when massive families were analysed. Pedigree analysis of real offspring demonstrated that 100% of the offspring were unambiguously allocated to their parents when two multiplex PCRs were used. The six sets of multiplex PCRs can be an important tool for tracing cultured individuals, population genetic analysis, and selective breeding program in *C. gigas*.

Key words Crassostrea gigas; traceability; microsatellites; universal primer; multiplex PCR; pedigree analysis

# 1 Introduction

Aquaculture industry has developed rapidly in recent years. In the future, the sustainable development of aquaculture will be progressively more market driven, and will rely heavily on its capacity to meet consumers' expectations (Yue *et al.*, 2012). Thus, the need for accurate product labelling to keep consumer confidence and ensure food-safety is obvious (Ogden, 2008). Traceability through physical labels is not highly reliable as physical labels can be easily changed or lost while DNA-based tracking system plays an increasingly important role for consumer protection and confidence building (Yue *et al.*, 2012). As a result, the application of genetic tools in supply chain traceability provides huge potential.

The Pacific oyster *Crassostrea gigas* is a highly valued cultivated oyster species. It has been introduced for aquaculture purposes in many locations worldwide except of its natural range (Kochmann *et al.*, 2012). As the quality of aquaculture products can vary greatly between farms, tracing *C. gigas* individuals to single farms is becoming increasingly important. Microsatellites, which possess the advantages of high polymorphism, codominance and conforming to Mendelian segregation, are the most popular markers in genetic studies. They have been preferred molecular markers to trace studbook information from the species down to the individual level in all types of organisms (Yu *et al.*, 2014). In *C. gigas*, a large number of genomic microsatellites have been developed (Li *et al.*, 2003; Sekino *et al.*, 2003; Yamtich *et al.*, 2005; Qi *et al.*, 2009). However, most of them are usually amplified by polymerase chain reaction (PCR) as single loci, a process that is time-consuming and expensive.

Multiplex polymerase chain reaction (PCR) is a variant of PCR in which two or more loci are simultaneously amplified in the same reaction (Henegariu *et al.*, 1997). To date, fourteen multiplex panels for *C. gigas* have been reported (Taris *et al.*, 2005; Li *et al.*, 2010; Miller *et al.*, 2012; Kang *et al.*, 2013; An *et al.*, 2013, 2014). They all directly labeled locus-specific primers with fluorescent dyes. More cost-effective end-labeling of PCR products can be achieved through a three primer PCR approach,

<sup>\*</sup> Corresponding author. Tel: 0086-532-82031622 E-mail: gili66@ouc.edu.cn

involving a fluorescently labeled universal primer in combination with modified locus-specific primers with 5' universal primer sequence tails (Blacket *et al.*, 2012). Based on the capillary electrophoresis technology and three primers PCR method, we developed six multiplex PCRs from previously described genomic microsatellites of *C. gigas* for quick and economic genetic analyses, and also validated their efficiency in parentage assignment with twelve single-pair mating families. It was proved that these six multiplex PCR sets are applicable not only for tracing cultivated oyster products, but also for selective breeding program and genetic resource conservation of *C. gigas*.

## 2 Materials and Methods

Sexually mature one-year-old oysters were selected for artificial spawning. Twelve single-pair mating families of *C. gigas* were produced. They were used to test the resolving power of the six genomic microsatellite multiplex PCRs. Tissues from all parents were saved in pure ethanol until DNA extraction. Forty D-larvae were collected from each family randomly, preserved in 100% ethanol, and kept in the fridge until used. For broodstocks, genomic DNA was extracted from ethanol-preserved adductor muscle tissue as previously described by Li *et al.* (2006). DNA concentration and quality of each sample were evaluated by NanoDrop 2000 spectrophotometer and 1% agarose gel electrophoresis, respectively. DNA of forty D-larvae from each family was prepared by the Chelexmodification extraction method following Li *et al.* (2003).

Genomic microsatellites were selected from previously characterized microsatellite markers (Li et al., 2003; Sekino et al., 2003; Yamtich et al., 2005; Qi et al., 2009) based on their level of polymorphism, allele size range, and reliability of allele calling. Firstly, all genomic microsatellites loci were validated with ten individuals in simplex reactions as described by Schuelke (2000), but not labeled with any fluorescent dye. Then, PCR products were analyzed via 6% denaturing polyacrylamide gels using a 10 bp ladder and visualized by silver staining. If the microsatellites presented low quality profiles, such as unspecific products, poor amplification and excessive stuttering, they were excluded from further analyses. Multiplex PCRs were arranged according to the annealing temperature and size of each primer to maximize the number of loci suitable for simultaneous analysis. M13tail with different fluorescent dyes (NED, VIC and FAM) were used so that products can be differentiated by capillary separation. The proper annealing temperature and primer concentration of each panel were then optimized using ten individuals. Multiplex PCRs were performed in 10-µL volume containing 0.25 U Taq DNA polymerase,  $1 \times PCR$  buffer, 0.2 mmol L<sup>-1</sup> dNTP mix, 2.0 mmol L<sup>-1</sup> MgCl<sub>2</sub>,  $0.15 \mu mol L^{-1}$  forward primer,  $0.15 \mu mol L^{-1}$  universal primer, 0.06 µmol L<sup>-1</sup> reverse primer, and about 50 ng template DNA. The amplifications were programmed using following conditions: 3 min at 94°C; 35 cycles of 30 s at 94°C, 60s at the optimal annealing temperature, and

75 s at 72°C; 8 cycles of 30 s at 94°C, 60 s at 53°C, 75 s at 72°C, with a final extension of 10 min at 72°C. For the subsequent genotyping step on ABI-3130 with LIZ500 as internal size standard, PCR products were diluted in pure water depending on their intensity. Fragment lengths were assessed with the GeneMapper v4.0 software.

We used Cervus 3.0 software (Kalinowski *et al.*, 2007) to assign parentage. This program calculates the number of alleles (*Na*), polymorphic information content (*PIC*), the observed heterozygosity (*Ho*), expected heterozygosity (*He*) and the combined non-exclusion probability in different situations. The genotype data of all offspring were pooled together to verify the resolving power of the multiplex panels in pedigree analysis. The simulation and real parentage analysis were conducted using the allele frequencies of 504 individuals (40 larvae and 2 parents of each family) in Cervus 3.0. The goodness-of-fit for expected Mendelian segregation ratios (1:1, 1:2:1, and 1:1:1:1) was measured by chi-square analysis module of SPSS 19.0 at the 0.05 probability level.

#### 3 Results and Discussion

Eighteen genomic microsatellite loci were selected and arranged into six multiplex PCRs that work well for C. gigas (Table 1). Electrophoregram of each multiplex panel showed high quality resolutions of alleles (Fig.1). Multiplex PCR is a valuable tool in various aspects such as gene deletion and mutation detection (Edwards et al., 1994), molecular species identification (Staudacher et al., 2011), as well as assessing aquaculture practices (Borrell et al., 2014). Instead of relying directly on labeling locus-specific primers developed in C. gigas (Taris et al., 2005; Li et al., 2010; Miller et al., 2012; Kang et al., 2013; An et al., 2013, 2014), we used universal tailed primer M13(-21) at each forward primer. Such a method allows the same level of marker multiplexing and accuracy in microsatellite genotyping attained in regular direct-labeled microsatellite fluorescent detection assays, while significantly reducing the costs (Guichoux et al., 2011). PCR cycling could be interrupted for the addition of the labeled primer only during the final cycles, thus minimizing unspecific amplification and competition between primers resulted in more fidelity amplification of the target regions (de Arruda et al., 2010). Blacket et al. (2012) reported a strategy in which multiple universal primers were used as tails on each locus-specific forward primer and multiple universal primers were labeled with different fluorophores. These strategies are worthy of consideration in subsequent studies on multiplex PCR to maximize locus amplification and reliability, as well as to further reduce the cost.

Genetic statistics for each locus are given in Table 2. Overall, the polymorphisms of the markers were moderate, with an average of 10.3 alleles per locus (ranged from 5 to 19) and average polymorphic information content of 0.740. The observed heterozygosity (*Ho*) and expected heterozygosity (*He*) ranged from 0.492 to 0.822 (average = 0.660) and 0.532 to 0.918 (average = 0.763), respec-

Table 1 Information of six multiplex PCRs									
Multinlay asta	Lagua	Та	Concentration of forward primer	Concentration of reverse primer					
Multiplex sets	Locus	(°C)	$(\mu mol L^{-1})$	$(\mu mol L^{-1})$					
	ucdCg-117	58	0.06	0.15					
Donal 1	ucdCg-120	58	0.06	0.15					
Panel 1	ucdCg-198	58	0.06	0.15					
	NED-M13(-21)	53	-	0.15					
	ucdCg-146	58	0.06	0.15					
Panel 2	Crgi3	58	0.06	0.15					
	uscCgi-210	58	0.06	0.15					
	FAM-M13(-21)	53	_	0.15					
	ucdCg-170	58	0.06	0.15					
Panel 3	ucdCg-156	58	0.06	0.15					
	ucdCg-199	58	0.06	0.15					
	VIC-M13(-21)	53	-	0.15					
	otgfa0_0007_B07	50	0.06	0.15					
Panel 4	otgfa0_0129_E11	50	0.06	0.15					
	Crgi4	50	0.06	0.15					
	FAM-M13(-21)	53	-	0.15					
	ucdCg-152	50	0.06	0.15					
Panel 5	Crgi39	50	0.06	0.15					
	Crgi45	50	0.06	0.15					
	VIC-M13(-21)	53	-	0.15					
	ucdCg-200	54	0.06	0.15					
Panel 6	otgfa0_408293	54	0.06	0.15					
	otgfa0_0139_G12	54	0.06	0.15					
	NED-M13(-21)	53	_	0.15					

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Notes: Ta, annealing temperature.



Fig.1 Electrophoregrams of six multiplex panels. Horizontal axis shows the size ranges for each locus in base pairs (bp).

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Multiplex sets	Locus	Na	PIC	Но	Не	NE-1P	NE-2P	NE-PP	F (Null)
Panel 1	ucdCg-120	7	0.607	0.708	0.660	0.748	0.583	0.399	-0.0402
	ucdCg-198	12	0.869	0.729	0.822	0.390	0.241	0.090	0.0953
	ucdCg-117	19	0.912	0.768	0.918	0.283	0.165	0.044	0.0888
Panel 2	Crgi3	5	0.472	0.519	0.532	0.851	0.712	0.555	-0.0068
	ucdCg-146	17	0.877	0.822	0.887	0.366	0.224	0.076	0.0414
	uscCgi-210	9	0.796	0.703	0.818	0.525	0.351	0.168	0.0793
Panel 3	ucdCg-170	12	0.854	0.691	0.869	0.421	0.265	0.105	0.1136
	ucdCg-156	16	0.903	0.633	0.911	0.307	0.181	0.053	0.1830
	ucdCg-199	8	0.690	0.554	0.716	0.667	0.480	0.273	0.1285
Panel 4	otgfa0_0129_E11	12	0.858	0.761	0.872	0.413	0.259	0.102	0.0677
	Crgi4	6	0.589	0.492	0.642	0.767	0.604	0.423	0.1281
	otgfa0_0007_B07	10	0.716	0.662	0.751	0.632	0.455	0.261	0.0690
Panel 5	Crgi45	5	0.562	0.534	0.623	0.789	0.634	0.463	0.0720
	Crgi39	10	0.860	0.788	0.874	0.409	0.255	0.098	0.0455
	ucdCg-152	9	0.579	0.522	0.599	0.778	0.589	0.374	0.0769
Panel 6	otgfa0_408293	12	0.826	0.784	0.843	0.470	0.304	0.130	0.0384
	otgfa0_0139_G12	8	0.562	0.518	0.593	0.793	0.615	0.415	0.0594
	ucdCg-200	8	0.787	0.686	0.812	0.543	0.368	0.186	0.0879

Table 2 Characteristics of the six multiplex PCRs in Crassostrea gigas

Notes: *Na*, number of alleles; *PIC*, polymorphic information content; *Ho*, observed heterozygosity; *He*, expected heterozygosity; NE-1P, average non-exclusion probability for one candidate parent; NE-2P, average non-exclusion probability for one candidate parent given the genotype of a known parent of the opposite sex; NE-PP, average non-exclusion probability for a candidate parent pair; F (Null), frequency of null allele.

The results of the Cervus simulations revealed that only three multiplexes are required to reach 100% assignment even the number of candidate parents reached 400 (Fig.2). This is slightly higher than a previous study on great scallop (Morvezen *et al.*, 2013). It is most likely due to the relative higher polymorphic information content (*PIC*) and the number of markers in our study. The number of loci was always the most important single factor in determining the accuracy of assignments (Harrison *et al.*, 2013). Additionally, accurate parentage assignment depends not only on the properties of microsatellite markers, but also on the number of candidate parent pairs (Norris *et al.*, 2000). Therefore, the six panels would still possess potential appliance value when a great amount of families were analysed.



Fig.2 Assignment success rate of simulated genotype data at the 95% confidence level. Each multiplex was added in decreasing order of average polymorphic information content (*PIC*).

In practice, the actual parentage analysis was carried out with twelve single-pair mating families of *C. gigas*. The results demonstrated that 33% of all offsprings were correctly allocated to a pair of parents only based on the most informative multiplex PCR (Panel 3) with the real family data, and 100% of the offsprings were unambiguously assigned to their parents when more than two multiplex PCRs were used (Fig.3). This result is comparable with those reported for *C. gigas* (Li *et al.*, 2010) and *C. farreri* (Nie *et al.*, 2012) where assignment success rates of two multiplex PCRs were 97% and 100%, respectively.



Fig.3 Cumulative assignment success rates of simulated and real genotype data at the 95% confidence level. Each multiplex was added in decreasing order of average polymorphic information content (*PIC*).

Of the 216 genotypic ratios examined (Table 3), 20 genotypic ratios (9.3%) were not compatible with Mendelian segregation after accounting for the presence of null alleles, and 5 were monomorphic (2.3%) leading to offspring identical to the parents. Null alleles in each parental genotype were inferred from offspring genotypes. Among the 18 loci studied here, 89 of the 864 parental alleles were null alleles, which was 10.3% of the total alleles (18 loci  $\times$  24 parents  $\times$  2). One common phenomenon of microsatellites in bivalves is the presence of null alleles that fail to amplify to detected levels in the PCR assays. Microsatellites developed from C. gigas usually contained particularly high frequency null alleles. For instance, McGoldrick et al. (2000) revealed that frequencies of null alleles were above 20% of microsatellites in C. gigas stocks. Moreover, null alleles were detected in 46.7% of loci, accounting for 11.7% of the total alleles in a backcross family of C. gigas (Li et al., 2009). By contrast, our study showed a lower null allele frequency. A high level of sequence polymorphism in PCR primer binding sites may be responsible for the wide spread of null allele in C. gigas (Hedgecock et al., 2004). However, microsatellite loci affected by null alleles would probably not alter the overall outcome of assignment testing and could therefore be included in parentage analysis (Carlsson, 2008). The discriminatory power of a locus depends

on the distribution of its alleles among the parents, but not necessarily on the presence of null alleles (Wang *et al.*, 2010). Carlsson (2008) also reported that increased number of loci had more significant effect on the accuracy of assignment testing than the presence of null alleles. This information is valuable for population genetic studies of taxa that are prone to null alleles, as it may enable geneticists to utilize loci affected by null alleles (Carlsson, 2008).

In summary, we have developed and validated six genomic microsatellite multiplex panels using dye-labeled universal primer for *C. gigas*. This research provided a suit of cost-effective and accurate parentage analysis method that can be applied for tracing cultured oyster individuals, population genetic analysis, and selective breeding program in *C. gigas*.

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Family	Multiplex	Locus	Female	Male	Genotypes of progeny	Observed ratio	Expected ratio	p value
1	Panel 1	ucdCg-120	170/172	170/null	170/170:170/172:170/null:172/null	9:10:4:15	1:1:1:1	0.093
		ucdCg-198	234/246	234/246	234/234:234/246:246/246	6:23:11	1:2:1	0.341
		ucdCg-117	340/352	340/352	340/340:340/352:352/352	9:17:14	1:2:1	0.341
	Panel 2	Crgi3	171/183	171/183	171/171:171/183:183/183	11:17:9	1:2:1	0.795
		ucdCg-146	212/228	212/228	212/212:212/228:228/228	3:17:19	1:2:1	0.001
		uscCgi-210	null/346	null/342	null/null:null/342:null/346:342/346	11:8:8:12	1:1:1:1	0.727
	Panel 3	ucdCg-170	136/138	132/138	132/136:132/138:136/138:138/138	14:6:14:6	1:1:1:1	0.094
		ucdCg-156	null/null	179/null	179/null:null/null	20:18	1:1	0.746
		ucdCg-199	285/288	285/285	285/285:285/288	12:27	1:1	0.016
	Panel 4	otgfa0_0129_E11	179/183	179/183	179/179:179/183:183/183	8:25:6	1:2:1	0.191
		Crgi4	null/269	null/null	null/null:null/269	24:16	1:1	0.777
		otgfa0_0007_B07	297/307	297/307	297/297:297/307:307/307	10:24:5	1:2:1	0.186
	Panel 5	Cgri45	168/178	168/178	168/168:168/178:178/178	9:18:13	1:2:1	0.549
		Cgri39	218/222	218/224	218/218:218/222:218/224:222/224	10:11:10:9	1:1:1:1	0.978
		ucdCg-152	269/269	269/272	269/269:269/272	25:15	1:1	0.114
	Panel 6	otgfa0_408293	140/142	140/142	140/140:140/142:142/142	10:22:8	1:2:1	0.741
		otgfa0_0139_G12	193/195	193/193	193/193:193/195	17:23	1:1	0.343
		ucdCg-200	269/269	269/272	269/269:269/272	15:25	1:1	0.114
2	Panel 1	ucdCg-120	170/176	170/176	170/170:170/176:176/176	17:16:7	1:2:1	0.037
		ucdCg-198	null/252	252/261	null/252:null/261:252/252:252/261	9:10:12:9	1:1:1:1	0.896
		ucdCg-117	286/328	286/328	286/286:286/328:328/328	12:18:10	1:2:1	0.741
	Panel 2	Crgi3	171/183	183/183	171/183:183/183	20:20	1:1	1.000
		ucdCg-146	212/228	212/228	212/212:212/228:228/228	9:20:11	1:2:1	0.905
		uscCgi-210	null/null	285/null	285/null:null/null	21:19	1:1	0.752
	Panel 3	ucdCg-170	136/138	136/138	136/136:136/138:138/138	5:28:7	1:2:1	0.037
		ucdCg-156	167/179	167/179	167/167:167/179:179/179	7:26:7	1:2:1	0.165
		ucdCg-199	265/286	265/286	265/265:265/286:286/286	6:20:12	1:2:1	0.368
	Panel 4	otgfa0_0129_E11	173/181	173/177	173/173:173/177:173/181:177/181	12:10:10:7	1:1:1:1	0.727
		Crgi4	238/256	256/256	238/256:256/256	16:24	1:1	0.206
		otgfa0_0007_B07	269/297	297/297	269/297:297/297	22:17	1:1	0.423
	Panel 5	Cgri45	168/178	176/176	168/176:176/178	15:25	1:1	0.114
		Cgri39	270/270	250/270	250/270:270/270	16:24	1:1	0.206
		ucdCg-152	284/284	299/311	284/299:284/311	16:23	1:1	0.262
	Panel 6	otgfa0_408293	140/null	130/140	130/140:130/null:140/140:140/null	8:9:10:13	1:1:1:1	0.706
		otgfa0_0139_G12	165/195	193/195	165/193:165/195:193/195:195/195	8:14:8:10	1:1:1:1	0.494
		ucdCg-200	263/266	263/269	263/263:263/266:263/269:266/269	10:16:5:7	1:1:1:1	0.064
3	Panel 1	ucdCg-120	170/172	170/176	170/170:170/172:170/176:172/176	14:12:8:6	1:1:1:1	0.261
		ucdCg-198	234/261	234/246	234/234:234/246:234/261:246/261	8:11:7:14	1:1:1:1	0.392
		ucdCg-117	300/350	300/328	300/300:300/328:300/350:328/350	17:6:9:7	1:1:1:1	0.053
	Panel 2	Crgi3	171/183	171/183	171/171:171/183:183/183	2:19:1	1:2:1	0.003
		ucdCg-146	212/228	228/228	212/228:228/228	19:21	1:1	0.752
		uscCgi-210	286/342	286/342	286/286:286/342:342/342	10:21:9	1:2:1	0.928

(to be continued)

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Family	Multiplex	Locus	Female	Male	Genotypes of progeny	Observed ratio	Expected ratio	p value
	Panel 3	ucdCg-170	136/null	132/null	132/136:132/null:136/null:null/null	12:12:7:8	1:1:1:1	0.546
		ucdCg-156	null/null	null/215	null/null:null/215	22:18	1:1	0.527
		ucdCg-199	265/null	null/null	265/null:null/null	20:20	1:1	1.000
	Panel 4	otgfa0_0129_E11	181/null	177/null	177/181:177/null:181/null:null/null	12:10:9:9	1:1:1:1	0.896
		Crgi4	238/256	256/null	238/256:238/null:256/256:256/null	10:8:13:8	1:1:1:1	0.633
	D. 17	otgta0_0007_B07	297/297	297/297	29//29/	40	1	-
	Panel 5	Cgri45	168/178	1/8/1/8	108/1/8:1/8/1/8 218/222:218/mstl:222/mstl:221/mstl/	25:17	1:1	0.343
		Ugiloy	222/null	$\angle 10/\text{null}$	210/222.210/null:222/null:null/null null/null:null/272	11.9.11.9	1.1.111	0.940
	Panel 6	otofal 408202	null/2/2	134/mull	134/null/null/null	27.13	1.1 1·1	0.114
		otofa() 0130 G12	193/195	193/103	193/193·193/195	27.15	1.1	0.027
		ucdCg-200	null/null	null/266	null/null:null/266	15: 25	1:1	0.114
4	Donal 1	ucdCg 120	170/172	158/172	158/170.158/172.170/172.172/172	0.8.15.7	1.1.1.1	0.264
4	r allel 1	ucdCg-120	234/246	130/1/2 23 <u>4</u> /246	234/234·234/246·246/246	2.0.13.7 12·19·8	1.1.1.1	0.204
		ucdCg-117	340/350	300/350	300/340:300/350:340/350:350/350	11.10.13.6	1.2.1	0.055
	Panel 2	Crgi3	169/183	169/183	169/169/169/183/183/183	7.20.13	1.2.1	0.407
	1 41101 2	ucdCg-146	212/228	212/228	212/212:212/228:228/228	6:28:6	1:2:1	0.041
		uscCgi-210	342/346	342/346	342/342:342/346:346/346	7:25:8	1:2:1	0.279
	Panel 3	ucdCg-170	132/140	136/140	132/136:132/140:136/140:140/140	15:8:8:9	1:1:1:1	0.334
		ucdCg-156	165/215	167/179	165/167:165/179:167/215:179/215	9:8:10:11	1:1:1:1	0.913
		ucdCg-199	null/286	null/286	null/null:null/286:286/286	7:20:9	1:2:1	0.717
	Panel 4	otgfa0_0129_E11	179/183	179/183	179/179:179/183:183/183	13:20:7	1:2:1	0.407
		Crgi4	238/256	238/256	238/238:238/256:256/256	6:22:12	1:2:1	0.333
		otgfa0_0007_B07	299/307	299/307	299/299:299/307:307/307	6:30:4	1:2:1	0.006
	Panel 5	Cgri45	null/null	176/null	176/null:null/null	25:15	1:1	0.114
		Cgri39	250/256	250/250	250/250:250/256	22:18	1:1	0.527
		ucdCg-152	269/272	269/269	269/269:269/272	18:22	1:1	0.527
	Panel 6	otgta0_408293	140/144	140/144	140/140:140/144:144/144	12:20:8	1:2:1	0.670
		otgrau_0139_G12	193/193	109/183	107/173:183/193	20:15	1.1	0.398
-	<b>D</b>	ucucg-200	203/200	205/200	205/205/200/200	7.17.12	1.2.1	0.700
5	Panel 1	ucdCg-120	17/0/174	null/null	1/0/null:1/4/null	22:17	1:1	0.423
		ucaCg-198	243/249	246/258	245/246:245/258:246/249:249/258	12:6:10:10	1:1:1:1	0.572
	Danal 2	ucucg-11/	204/328	294/340 171/102	204/294.204/340:294/328:328/346 171/171-171/182-102/192	4.10.12.12	1.1.1.1	0.210
	ranei 2	ucdCg-146	1/1/183 2 <u>4</u> <u>4</u> /262	1/1/183	1/1/1/1/1.1/1/105.105/105 228/244-228/262-244/246-246/262	2.12.23 2·5·15·12	1.2.1	0.000
		uscCgi-210	339/345	339/339	339/339/339/345	19.20	1.1.1.1	0.873
	Panel 3	ucdCg-170	null/142	null/176	null/null:null/142:null/176:142/176	10:8:12:4	1:1:1:1	0.249
		ucdCg-156	229/229	213/229	213/229:229/229	21:18	1:1	0.631
		ucdCg-199	285/285	285/288	285/285:285/288	18:21	1:1	0.631
	Panel 4	otgfa0_0129_E11	169/null	165/177	165/169:165/null:169/177:177/null	2:13:5:20	1:1:1:1	0.000
		Crgi4	238/256	238/256	238/238:238/256:256/256	8:18:14	1:2:1	0.333
		otgfa0_0007_B07	299/305	293/299	293/299:293/305:299/299:299/305	18:9:8:4	1:1:1:1	0.013
	Panel 5	Cgri45	168/178	168/178	168/168:168/178:178/178	13:12:13	1:2:1	0.076
		Cgri39	220/224	216/222	216/220:216/224:220/222:222/224	9:9:9:4	1:1:1:1	0.490
	_	ucdCg-152	269/284	269/284	269/269:269/284:284/284	16:18:6	1:2:1	0.067
	Panel 6	otgfa0_408293	null/148	null/152	null/null:null/148:null/152:148/152	5:16:5:13	1:1:1:1	0.021
		otgta0_0139_G12	181/193	181/193	181/181:181/193:193/193	9:19:12	1:2:1	0.760
		ucdCg-200	260/263	257/272	25//260:25//263:260/272:263/272	/:8:14:10	1:1:1:1	0.400
6	Panel 1	ucdCg-120	170/172	172/172	170/172:172/172	31:6	1:1	0.000
		ucdCg-198	255/267	261/264	255/261:255/264:261/267:264/267	14:6:12:8	1:1:1:1	0.261
		ucdCg-117	288/302	294/308	288/294:288/308:294/302:302/308	11:9:10:10	1:1:1:1	0.978
	Panel 2	Urg13	171/183	171/183	1/1/1/1:1/1/183:183/183	10:21:9	1:2:1	0.928
		ucaUg-146	258/260	246/250	240/258:240/260:250/258:250/260 222/pull.pull/242	9:9:11:11	1:1:1:1	0.940
	Danal ?	uscUgl-210	333/342 138/144	nuii/nuii 139/144	555/HUIL.HUII/542 138/138·138/146·146/146	24.10 14:16:10	1.1 1.2.1	0.206
	r allel 3	ucucg-170 ucdCg-156	130/140	130/140	150/150.150/140.140/140 171/175·171/185·175/185·185/185	14.10.10	1.2.1 1.1.1.1	0.501
		ucdCg-199	285/285	2.64/288	264/285:285/288	23.16	1.1.1.1	0.873
	Panel 4	otgfa0 0129 E11	179/183	171/179	171/179:171/183:179/179·179/183	11:6:14.9	1:1:1:1	0.334
		Crgi4	238/255	238/255	238/238:238/255:255/255	9:21:10	1:2:1	0.928
		otgfa0_0007_B07	297/299	297/299	297/297:297/299:299/299	9:19:12	1:2:1	0.760

(to be continued)

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(00)	пипи	ea)

Panel 5         Cgn39         104/12         12/22         12/12/22         12/14         12/14         12/14         12/14           Panel 6         0pfa0, 40239         200/20         200/202/07/8         21/19         1.1         0.752           Panel 6         0pfa0, 40239         13/14/2         13/14/3	Family	Multiplex	Locus	Female	Male	Genotypes of progeny	Observed ratio	Expected ratio	<i>p</i> value
Cgr.39         214/21 216/22         214/16.214/22         21.19         1.1         0.752           uedGq-152         00/878         20/878         20/878         21:19         1:10         0.752           uedGq-152         00/810         10/813         138/138         138/138         138/142         1:10         0.527           vedGq-120         10/171         10/171         10/171         10/171         10/172         24/16         1:1         0.532           vedGq-160         24/267         26/264         24/3264/26/267         0.20         1:1         0.752           uedGq-161         01/11         27/39         339/31         52/39/32         21/19         1:1         0.752           uedGq-170         14/14         130/14         20/14/14/14/14         1:1         0.72         1:1         0.752           uedGq-170         14/14         130/14         130/14/14/14/14         1:1         0.16         1:1         0.72           uedGq-161         14/14         130/14         130/14/14/14/14         1:1         0.16         1:1         0.72           uedGq-170         14/14         130/14         130/14/14/14/14         1:1         0.16         1:1         0.26		Panel 5	Cgri45	168/178	168/178	168/168:168/178:178/178	9:17:14	1:2:1	0.341
uedC         200270         2002/09         2002/09         2002/09         2012/09         20			Cgri39	214/214	216/222	214/216:214/222	21:19	1:1	0.752
Panel 6         oigfab (13) 2012         128/138         138/138/138/142         11.28         1.1         0.057           vedCg-200         null244         null224         null227         nullmull.null224/22248         899.14         1.1.11         0.532           7         Panel 1         uedCg-120         170170         170172         241.6         1.1         0.030           uedCg-117         nullmull 264/244264/267         201.9         1.1         0.732           uedCg-146         222.38         242.42         2224/22.38/242         201.9         1.1         0.732           uedCg-146         222.38         235.435         357.335.37/445.39/31.39/33.93/45         7.158.510         1.1.1         0.264           uedCg-156         165/165			ucdCg-152	269/278	269/269	269/269:269/278	21:19	1:1	0.752
ordgfa00         10126         100140		Panel 6	otgfa0_408293	138/142	138/138	138/138:138/142	11:28	1:1	0.006
uedCg-200         null224         null227         nullnullnull224         null224         null234         null334			otgfa0_0139_G12	169/173	169/169	169/169:169/173	18:22	1:1	0.527
7         Panel 1         ucdCq-190         170172         170172         2416         1.1         0.000           ucdCq-193         ucdCq-107         nullinull         286294         286404         243267         242647         20.019         1.1         0.000           ucdCq-146         22238         242242         232733-2273453393393393         1758:10         1.111         0.752           ucdCq-10         34734         103141         103141414144         21:19         1.1         0.752           ucdCq-156         165165         165165         165165         165165         165165         100.071         1.1         0.752           ucdCq-150         285282         25282528528528         127.171         1.1         0.752           ucdCq-150         1651715         1651715         1651715         100.071         10.10.9711         1.1:1         0.012           ucdCq-152         20262         222224         220224         220224         10.02.7         1.1         0.21           ucdQ-152         100172         170172         170172         170172         170172         170172         170172         170172         170172         170172         170172         170172         170172			ucdCg-200	null/284	null/272	null/null:null/272:null/284:272/284	8:9:9:14	1:1:1:1	0.532
uedGe_1198         243/26         243/264/224/267         20:20         1:1         1.000           uedGe_116         220/38         183/183         183/183         1:1         0.732           uedGe_146         222.03         139/34         527/393         373/34         393/34         57.158.10         1:1.1         0.752           uedGe_150         154/156         165/156         165/156         40         1         -           uedGe_170         134/13         130134         130134/134/134         21:19         1:1.1         0.316           uedGe_150         165/156         165/156         167/156         167/156         167/156         1.0         0.0         -           uedGe_170         158/171         1721         171/171/171/171/171/171/171/171/171/171	7	Panel 1	ucdCg-120	170/170	170/172	170/170:170/172	24:16	1:1	0.206
uedGe_117         mulhul         286/29         286/mulhunU294         20-19         1.1         0.752           uedGe_104         2223         22242.238         22242.238/303.339.339.34         71.58.10         1.1.1         0.752           uedGe_107         134/13         1307134.134/134         211.9         1.1         0.752           uedGe_108         156/165         165/165         165/165         40         1         -           uedGe_10129_E11         181/181         171/17         171/17.171/1813179/181.179/181         0.109.11         1.1.1         0.752           uedGe_102         Crgi4         238/256         238/256         238/256         237.171         1.2.1         0.762           vedGe_152         Crgi4         238/256         238/256         237.171         1.2.1         0.762           vedGe_152         269/73         238/256         237.278/278         257.7         1.2.1         0.301           uedGe_1013<0.12			ucdCg-198	243/267	264/264	243/264:264/267	20:20	1:1	1.000
Panel 2         Crgi3         183/183         183/183         183/183         121-9         1-1         0.752           uscGcj-10         327/39         399/345         327/39-327/45339/339/339/345         71.55:10         1.11.1         0.752           uscGg-170         134/134         130/134 <t< td=""><td></td><td></td><td>ucdCg-117</td><td>null/null</td><td>286/294</td><td>286/null:null/294</td><td>20:19</td><td>1:1</td><td>0.873</td></t<>			ucdCg-117	null/null	286/294	286/null:null/294	20:19	1:1	0.873
uedGe_146         22238         24224         2224242238/242         19-21         1.1         0.732           uedGe_170         13/14         130134-132/139/359/359/359/359/359/359/359/359/359/3		Panel 2	Crgi3	183/185	183/183	183/183:183/185	21:19	1:1	0.752
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			ucdCg-146	222/238	242/242	222/242:238/242	19:21	1:1	0.752
Panel 3         uedCq:10         134/134         130/134:134/134         21:19         1:1         0.752           uedCq:19         283/288         285/288         285/285         285/288         17:21         1:1         0.516           Panel 4         otgfa0.0129_E11         181/183         171/179         171/171:171/183:179/181:179/183         10:10-9:11         1:21:1         0.621           Crgi4         238/256         288/258         288/238:23252:256/256         12:17:11         1:21:1         0.621           Veroid 5         Crgi45         168/178         168/6186/175:178/178         9:17.14         1:21:1         0.308           uedCg:120         200224         220224         220222-220224:22224:224224         1:21:1         0.636           uedCg:10         170/172         170/172         12:11         0.208         0.008         0.008         0.008         0.008         0.008         0.008         0.008         0.008         0.001         0.011         0.111         0.013         0.013         0.014         0.014         0.014         0.014         0.014         0.014         0.014         0.014         0.014         0.014         0.014         0.011         0.011         0.011         0.011         0.011<			uscCgi-210	327/339	339/345	327/339:327/345:339/339:339/345	7:15:8:10	1:1:1:1	0.284
uedCg-156         165/165         165/165         165/165         10         1         -           uedCg-150         285/28		Panel 3	ucdcg-170	134/134	130/134	130/134:134/134	21:19	1:1	0.752
uedCg-199         285/288         285/285			ucdCg-156	165/165	165/165	165/165	40	1	-
Panel 4         orgia0_0129_E11         181/183         171/171         171/171         171/183         179/183         10:109*11         11:1:1         0.072           orgia0_0007_B07         297/mul         null/null         297/mull         168/178         168/178         168/178         168/178         168/178         168/178         168/178         171/11         1:2:1         0.026           Cgri30         200224         222/224         220/222.202/224/222/224         220/222.202/224/222/224         1:5:7:9         1:1:1         0.036           ucdCg-152         209/278         260/270         260/269.209/278:278/278         8:25:7         1:2:1         0.740           ucdCg-100         170/172			ucdCg-199	285/288	285/285	285/285:285/288	17:21	1:1	0.516
Craji 4         238/256         238/236         238/236         238/236         1:1         0.206           orgfa0         0007_B07         207/multinultunul         16:24         1:1         0.206           Panel 5         Cgri 45         168/178         168/178:178/178         9:17:14         1:2:1         0.301           ucdCg-152         209/27         220/224         220/224         220/224         220/224         1:5:0:7         1:2:1         0.301           ucdCg-152         209/27         260/260         209/272         1:1:1         0.005           ucdCg-100         1201/21         170/172         170/170:170/172:172/172         1:1:1         0.005           ucdCg-117         308/312         302/30         302/308:302/312         0:2:0         1:1         0.333           ucdCg-146         242/254         24/4252         24/24/24/24/24/24/24/24/24/24/24/24/24/2		Panel 4	otgfa0_0129_E11	181/183	171/179	171/171:171/183:179/181:179/183	10:10:9:11	1:1:1:1	0.978
otgfa0_0007_B07_207         297/mult         null/null         16:24         1:1         0.20           Panel 5         Cgri3 b         200724         220/224         220/224         220/224         220/224         220/224         12:1         0.308           ucdCg-152         209/278         269/278         269/278         269/278         82:57         1:2:1         0.308           ucdCg-152         209/278         18/193         138/140:140/152         16:24         1:1         0.308           ucdCg-102         233/20         266/272         26/272         26/272         10:11:9         11:11         0.903           8         Panel 1         ucdCg-198         null/null         23/266         23/372.266/299/2072         10:11:9         11:11         0.903           9         Panel 1         ucdCg-10         170/172         170/172         170/172         170/172         170/173         171.11         0.434           0         ucdCg-10         34/245         33/342         33/342         20:20         11         1.000           1         0.426         24/255         24/41/242         22/25/24/42/24/24/24/25/22/24/24         13/14         14/14         13/14         13/14         13/14			Crgi4	238/256	238/256	238/238:238/256:256/256	12:17:11	1:2:1	0.622
Panel 5         Cgri45         168/178         168/178         168/178         178/178         9-17.14         1.2:1         0.338           ucdCg-152         269/278         220222         2202222022222222222222222222222222222			otgfa0_0007_B07	297/null	null/null	297/null:null/null	16:24	1:1	0.206
$ \begin{array}{c} {\rm Cgri}{39} & 220/24 & 22/24 & 22/22.22/22.22/22.42.22/22.42.22/22.4 & 23/22.4 & 23/2.94 & 23/2.97 & 1:1:1:1 & 0.206 \\ {\rm otgfa0_013_0(12 & 181/193_193/193_181/193/193_142.66 & 1:1 & 0.058 \\ {\rm uedCg_{2:0} & 26/3/20_2 & 26/3/22_0 & 26/3/22_0 & 26/3/22_0 & 26/3/22_0 & 26/3/22_0 & 26/3/22_0 & 26/3/20_0 & 26/3/$		Panel 5	Cgri45	168/178	168/178	168/168:168/178:178/178	9:17:14	1:2:1	0.341
vecdcg-152         269/278         269/278         269/278         269/278         278/278         8:27         1:2:1         0.276           vecdcg-200         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/27         263/26         266/26         269/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261/27         261/26         261			Cgri39	220/224	222/224	220/222:220/224:222/224:224/224	15:9:7:9	1:1:1:1	0.308
Panel 6         otgfa0, 048293         138/152         140/140         138/140/140/152         16.24         1:1         0.206           otgfa0, 0139         GL         18/193         193/193         14.26         1:1         0.058           ucdCg-200         263/269         266/272         263/266/263/272/266/269/269/272         9:10:11:9         1:1:1:1         0.963           8         Panel 1         ucdCg-108         mult/mult/131/24         170/172         170/173         170/173         170/172         170         134/13         1340/143/133/133/183         427/170         140.0400         ucdCg-166         157/138         133/133/133/133         23:17         1:1         0.352           Panel 4         otgfa0, 0129_E11         165/177         167/183         165/167/165/183/163/176/177         10:10:10         1:1:1:1         0.058           otgfa0, 0007_B07         295/295         297/29         295/297/295/292/99         14-25         1:1         <			ucdCg-152	269/278	269/278	269/269:269/278:278/278	8:25:7	1:2:1	0.279
otgfa0_0139_G12         181/193         193/193         14.26         1:1         0.058           ucdCg-200         263/266         266/272         263/266:263/272.266/269:269/272         9:10:11:9         11:1:1         0.963           8         Panel 1         ucdCg-120         170/172         170/170:172:172/172         12:18:10         1:2:1         0.741           ucdCg-170         308/312         302/308:302/312         20:20         1:1         0.000           Panel 2         Crg3         171/183         171/171:171/183:183/183         4:27:9         1:2:1         0.046           ucdCg-170         134/136         134/134:134/136:136/136         6:20:14         1:2:1         0.202           ucdCg-170         134/136         134/134:134/136:136/136         6:20:14         1:2:1         0.202           ucdCg-170         134/136         134/134:134/136:136/136         6:20:14         1:2:1         0.203           ucdCg-190         285/28         285/285:285/286         21:1         1.033         1:1:1:1         1.000           Crgi4         238/256         238/256         238/256         236/256/256         1:1:1         1.010           Crgi4         238/256         238/256         238/256/256/256		Panel 6	otgfa0_408293	138/152	140/140	138/140:140/152	16:24	1:1	0.206
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			otgfa0_0139_G12	181/193	193/193	181/193:193/193	14:26	1:1	0.058
8         Panel 1         uedCg-120         170/172         170/172         172172         12:18:10         1:2:1         0.741           uedCg-117         38/312         302/308         302/308         302/308         302/312         20:20         1:1         1.000           Panel 2         Crgi3         171/183         171/171:171/183         183/183         4:27:9         1:2:1         0.046           uedCg-110         342/345         333/342:333/345:33/345:33/345         9:14:9:8         1:1:1:1         0.532           Panel 3         uedCg-170         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         134/136         136/177         177.178         10:10:10         1:1:1         0.302           uedCg-190         255         257255         258/258         28/258         28/258         11         0.075           Panel 4         otgfa0_0129_E11         165/177         167/183         165/176/165/183/167/177/177/183         10:10:10         1:1:1         0.502           Orgi4 2         28/262         228/262			ucdCg-200	263/269	266/272	263/266:263/272:266/269:269/272	9:10:11:9	1:1:1:1	0.963
uedCg-198         nullnull         234/264         234/nullnull/264         7.23         1:1         0.343           uedCg-117         308/312         302/302         302/308:302/312         20:20         1:1         1.000           uedCg-146         24/254         230/202         302/308:302/312         20:20         1:1         0.040           uedCg-146         24/254         24/252         24/24/24/252:224/254:252/254         14.7:10-8         1:1:1:1         0.040           uedCg-170         134/3         134/134:134:136:136/136         6:20-14         1:2:1         0.202           uedCg-199         285/285         285/285:285/288         23:17         1:1         0.343           uedCg-199         285/285         285/285:285/288         1:11:1         0.072           otgfa0_0007_B07         29:5/29         29:729         29:5/297.29:5/29         1:14:25         1:1         0.078           Cgri30         20022         22:0222         22:0222:22:22/22         25:15         1:1         0.114           uedCg-152         269/269         269/279         29:529         1:4:25         1:1         0.739           uedCg-152         209/269         269/272         20:20         1:1         0.739	8	Panel 1	ucdCg-120	170/172	170/172	170/170:170/172:172/172	12:18:10	1:2:1	0.741
uedCg-117         308/312         302/302         302/308/302/312         20.20         1:1         1.000           Panel 2         Crgi3         171/183         171/171:171/183:183/183         427.9         1:2:1         0.046           uedCg-146         42/245         32/252         42/242/252:24/42/25:252/45         47:710-8         1:1:1:1         0.532           Panel 3         uedCg-170         13/41/36         13/41/34:13/41/36:13/61/36         6:20:14         1:2:1         0.202           uedCg-166         175/183         183/183         175/183:183/183         23:17         1:1         0.343           uedCg-199         285/28         285/285         285/285:285/288         21:19         1:1         0.752           Panel 4         otgfa0_0129_E11         165/177         167/183         165/178:13/167/177:177/183         10:10:10:10         1:1:1:1         1.000           Crgi4         238/250         238/250         238/256:256/256         10:15:8         1:2:1         0.753           Panel 5         Cgri45         168/178         168/178:178/178         9:16:10         1:2:1         0.875           otgfa0_0139_G12         23/192         20/222         220/222         20/222.2272/22         20:5:15         1:1 <td></td> <td></td> <td>ucdCg-198</td> <td>null/null</td> <td>234/264</td> <td>234/null:null/264</td> <td>17:23</td> <td>1:1</td> <td>0.343</td>			ucdCg-198	null/null	234/264	234/null:null/264	17:23	1:1	0.343
Panel 2         Crgi3         171/183         171/171/183         171/171/183.183/183         4:27:9         1:2:1         0.046           ucdCg-16         242/254         244/253         242/244:242/252:224/254:252/254         14:7:10:8         1:1:1:1         0.400           uscCgi-210         134/136         134/136         134/136/136/136         6:20:14         1:2:1         0.202           ucdCg-156         175/183         183/183         175/183.183/183         23:17         1:1         0.343           ucdCg-190         285/28         285/285         285/288         21:19         1:1         0.752           Panel 4         otgfa0_007_B07         295/295         295/297:295/299         14:25         1:1         0.078           Crgi4         238/256         238/256         238/238/236/236/256         10:15.8         1:2:1         0.773           otgfa0_0007_B07         25/295         297/299         295/297:295/299         14:25         1:1         0.078           vedGg-152         26/96         26/9722         20/222:222/22         20:221         25:15         1:1         0.144           ucdGg-149         14/151         14/161/161/152         17:19         1:1         0.739           ucdGg			ucdCg-117	308/312	302/302	302/308:302/312	20:20	1:1	1.000
uedCg-146         242/254         242/254         242/254         242/254         147:10:8         1:1:1:1         0.400           uedCg-170         134/136         1		Panel 2	Crgi3	171/183	171/183	171/171:171/183:183/183	4:27:9	1:2:1	0.046
uscCgi-210         342/34         333/342/333/345/339/342/339/345/339/342/339/345         9/14/98         1:1:1:1         0.532           Panel 3         ucdCg-170         134/136         134/136         134/136         134/136         134/136         124/136         134/136         122/14         122:1         0.202           ucdCg-156         175/183         183/183         175/183         183/183         175/183         183/17         161         0.752           Panel 4         otgfa0_012_PE11         165/177         167/183         165/167/165/183:167/177/1771         1010:10:10         11:1:1         0.075           otgfa0_0007_B07         295/255         297/259         295/256/256/256         10:15:8         12:1         0.773           otgfa0_0007_B07         295/252         220/222         220/222         220/222         220/222         220/222         220/222         220/222         220/222         220/22         20/22         20/24         210/26 <t< td=""><td></td><td></td><td>ucdCg-146</td><td>242/254</td><td>244/252</td><td>242/244:242/252:244/254:252/254</td><td>14:7:10:8</td><td>1:1:1:1</td><td>0.400</td></t<>			ucdCg-146	242/254	244/252	242/244:242/252:244/254:252/254	14:7:10:8	1:1:1:1	0.400
Panel 3         ucdCg-170         134/136         135/138         110         0.0134         0.0121         0.0121         0.0134         0.0121         0.0134         0.0134         0.0134         0.0134         0.0134         0.0134         0.0134         0.0134         0.0134         0.0134         0.0134         0.0136         0.013         0.011         0.0007         0.013         0.0112         0.0172         0.0222         0.0222         0.02222         0.02222         0.02222         0.0222         0.0222         0.0222         0.0222         0.0222         0.0222         0.0222         0.0222         0.0222         0.022			uscCgi-210	342/345	333/339	333/342:333/345:339/342:339/345	9:14:9:8	1:1:1:1	0.532
ucdCg-156         175/183         183/183         175/183         183/183         23:17         1:1         0.343           ucdCg-199         285/288         285/285         285/285         285/285         285/285         21:19         1:1         0.752           Panel 4         otgfa0_0129_E11         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         167/183         165/177         17/183         17/17         17/10         17/1         0.075           Cgri39         220/222         220/222         220/222         220/222         220/22         20/22         17/1         1         0.000           ucdCg-152         269/269         269/272         269/269         163/17         17/18         17/17         17/17         17/17         17/17         17/17         17/17         17/17		Panel 3	ucdCg-170	134/136	134/136	134/134:134/136:136/136	6:20:14	1:2:1	0.202
ucdCg-199         285/285         285/285         285/285         285/285         21:19         1:1         0.752           Panel 4         otgfa0_0129_E11         165/177         167/183         165/167:165/183:167/1777:177183         10:10:10:10         11:1:1:1         1.000           Crgi4         238/256         236/257         20:221         232/22         22:22/22         20:222/222         20:22         20:22         20:22         20:22         10:10         10:00           vacdCg-152         269/269         20:49/269         29:27         29:20         20:20         11         0.000			ucdCg-156	175/183	183/183	175/183:183/183	23:17	1:1	0.343
Panel 4         otgfa0_0129_E11         165/177         167/183         165/167/177:177/183         10:10:10:10         1:1:1:1         1.000           Crgi4         238/256         238/256         238/256:256/256/256         10:15:8         1:2:1         0.773           otgfa0_0007_B07         295/295         297/299         295/297:295/2999         14:25         1:1         0.078           Panel 5         Cgri45         168/178         168/178         168/178:178/178         9:16:10         1:2:1         0.855           Cgri39         220/222         220/222         220/222:222/22         20:20         1:1         0.014           ucdCg-152         269/269         269/272         269/269/269/272         20:20         1:1         0.739           otgfa0_0408293         140/152         17:19         1:1         0.739           ucdCg-100         null/269         263/269         263/null:263/269:null/269:269/269         10:8:12:9         1:1:1:1         0.826           9         Panel 1         ucdCg-120         170/172         170/172         170/172         170/172         1723         1:1         0.343           ucdCg-146         242/249         294/294:294/302         14/264         10:10:9:8         1:1:1:1 <td></td> <td></td> <td>ucdCg-199</td> <td>285/288</td> <td>285/285</td> <td>285/285:285/288</td> <td>21:19</td> <td>1:1</td> <td>0.752</td>			ucdCg-199	285/288	285/285	285/285:285/288	21:19	1:1	0.752
Crgi4         238/256         238/238/238/238/236/256/256/256         10:15:8         1:2:1         0.773           otgfa0_0007_B07         295/295         297/297         295/297:295/299         14:25         1:1         0.078           Panel 5         Cgri45         168/178         168/178         168/178         16:10         1:2:1         0.855           Cgri39         220/222         222/222         220/222:222/222         25:15         1:1         0.114           ucdCg-152         269/269         269/272         269/269/272         20:20         1:1         1.000           Panel 6         otgfa0_0139_G12         139/193         193/193         193/195         193/193:193/195         191/17         1:1         0.739           ucdCg-100         null/269         263/269         263/null:263/269:null/269:269/269         10:8:12:9         1:1:1:1         0.826           9         Panel 1         ucdCg-170         170/172         170/170:170/172:172/172         9:23:8         1:2:1         0.622           ucdCg-182         261/261         261/264         216/264         1:1:0         0.343           ucdCg-170         null/13         171/183         171/171:171/183:183/183         8:23:9         1:2:1         0.6		Panel 4	otgfa0_0129_E11	165/177	167/183	165/167:165/183:167/177:177/183	10:10:10:10	1:1:1:1	1.000
otgfad_0007_B07         295/295         297/299         295/297/297/297/297/297         14:25         1:1         0.078           Panel 5         Cgri45         168/178         168/168:168/178:178/178         9:16:10         1:2:1         0.855           Cgri39         220/222         222/222         20:0222:22/222         25:15         1:1         0.114           ucdCg=152         269/269         269/272         20:20         1:1         1.000           Panel 6         otgfa0_408293         140/152         140/140         140/140:140/152         17:19         1:1         0.739           otgfa0_0139_G12         193/193         193/195         193/193:193/195         19:17         1:1         0.739           ucdCg=100         null/269         263/269         263/269:null/269:269/269         10:8:12:9         1:1:1:1         0.826           9         Panel 1         ucdCg-120         170/172         170/170:170/172:172/172         9:23:8         1:2:1         0.622           ucdCg=146         242/246         238/244         238/242:238/246:242/244:244/246         1:1         0.961           ucdCg=110         39/339         333/342         333/393/393/342         23:16         1:1         0.262           uc			Crg14	238/256	238/256	238/238:238/256:256/256	10:15:8	1:2:1	0.773
Panel 5         Cgri45         168/178         168/178         168/178         168/178         168/178         9:16:10         1:2:1         0.855           Cgri39         220/222         222/222         222/222         222/222         25:15         1:1         0.114           ucdCg-152         269/269         269/272         269/269/272         20:20         1:1         1.000           Panel 6         otgfa0_0139_G12         193/193         193/193         193/193         193/195         19:17         1:1         0.739           ucdCg-200         null/269         263/269         263/269         263/269         108:12:9         1:1:1:1         0.826           9         Panel 1         ucdCg-120         170/172         170/172         170/172:172/172         9:23:8         1:2:1         0.622           ucdCg-177         294/294         294/302         294/294/294/302         294/294/294/302         14:26         1:1         0.343           ucdCg-164         242/246         238/242         238/246:242/248:244         10:10:9:8         1:1:1:1         0.961           ucdCg-170         null/null         null/136         null/null         11/136         11/11         11         0.516		D 15	otgta0_000/_B0/	295/295	297/299	295/297:295/299	14:25	1:1	0.078
Vertical Science         220/222         220/222         220/222         220/222         25:15         1:1         0.114           ucdCg-152         269/269         269/269         269/269:269/272         20:20         1:1         1.000           Panel 6         otgfa0_0139_G12         193/193         193/195         193/195         19:17         1:1         0.739           ucdCg-200         null/269         263/269         263/null:263/269:null/269:269/269         108:12:9         1:1:1:1         0.826           9         Panel 1         ucdCg-120         170/172         170/172         170/170:170/172:172/172         9:23:8         1:2:1         0.622           ucdCg-117         294/294         294/302         294/294:294/302         14:26         1:1         0.383           ucdCg-146         242/246         238/244         238/242:238/246:242/244:246         10:10:9:8         1:1:1         0.961           ucdCg-156         183/183         183/187         183/183/183         8:23:9         1:2:1         0.622           ucdCg-199         285/285         285/285         285/285         233/39/342         233:16         1:1         0.262           Panel 3         ucdCg-170         null/null         null/136		Panel 5	Cgri45	168/178	168/178	168/168:168/1/8:1/8/1/8	9:16:10	1:2:1	0.855
Panel 6       otgfa0_408293       140/152       140/140       140/140:140/152       17:19       1:1       0.739         otgfa0_0139_G12       193/193       193/195       193/193:193/195       19:17       1:1       0.739         ucdCg-200       null/269       263/269       263/269       1263/269:null/269:269/269       10:8:12:9       1:1:1       0.826         9       Panel 1       ucdCg-10       170/172       170/172       170/170:170/172:172/172       9:23:8       1:2:1       0.622         ucdCg-117       294/294       294/292       294/294:294/302       14:26       1:1       0.588         Panel 2       Crgi3       171/183       171/1713       171/1713/1713/183/183       8:23:9       1:2:1       0.622         ucdCg-146       242/246       238/244       238/242:238/246:242/244:244/246       10:10:9:8       1:1:1:1       0.961         uscCgi-210       339/339       33/342       33/339:339/342       23:16       1:1       0.262         ucdCg-156       183/183       183/187       183/183/187       17:21       1:1       0.516         ucdCg-199       285/285       285/288       17:21       1:1       0.516         ucdCg-199       285/285       285/285			Cgri39	220/222	222/222	220/222:222/222	25:15	1:1	0.114
Panel 6       otgra0_408295       140/152       17/19       11       0.759         otgra0_0139_G12       193/193       193/195       193/193/193/195       19:17       1:1       0.739         ucdCg-200       null/269       263/269       263/null:263/269:null/269:269/269       10:8:12:9       1:1:1:1       0.826         9       Panel 1       ucdCg-120       170/172       170/172       170/172:172/172       9:23:8       1:2:1       0.622         ucdCg-198       261/261       261/264       261/261:261/264       17:23       1:1       0.343         ucdCg-17       294/294       294/294       294/294/294/294/294/294       238/242:238/246:242/244:244/246       10:10:9:8       1:1:1:1       0.622         ucdCg-170       null/null       null/null       null/null		Den al (	ucdCg-152	269/269	269/272	269/269:269/272	20:20	1:1	1.000
9       Panel 1       ucdCg-120       170/172       170/172       170/172/172       170/172/172       9:23:8       1:2:1       0.826         9       Panel 1       ucdCg-120       170/172       170/172       170/172/172/172       9:23:8       1:2:1       0.622         ucdCg-198       261/261       261/264       261/261/264       17:23       1:1       0.343         ucdCg-117       294/294       294/302       294/294/294/302       14:26       1:1       0.622         ucdCg-146       242/246       282/244       283/242:238/246:242/244:244/246       10:10:9:8       1:1:1       0.622         ucdCg-170       null/null null/136       11/1/183       171/183:183/183       8:23:9       1:2:1       0.622         ucdCg-170       null/null null/136       101/171:171/183:183/183       8:23:9       1:2:1       0.622         ucdCg-170       null/null null/136       101/136:1011/null       17:21       1:1       0.516         ucdCg-199       285/285       285/288       285/285/288       17:21       1:1       0.516         ucdCg-199       285/256       256/null       256/256/256/null       23:17       1:1       0.343         ucdCg-152       269/269       251/269		Panel 6	$otg1a0_408293$	140/152	140/140	140/140:140/152	17:19	1.1	0.739
9       Panel 1       ucdCg-120       170/172       170/172       170/172:172/172       9:23:8       1:2:1       0.622         9       Panel 1       ucdCg-198       261/261       261/264       261/264       261/264       17:23       1:1       0.343         ucdCg-198       261/261       261/264       261/264       261/264       17:23       1:1       0.343         ucdCg-117       294/294       294/302       294/294:294/302       14:26       1:1       0.058         Panel 2       Crgi3       171/183       171/171:171/183:183/183       8:23:9       1:2:1       0.622         ucdCg-146       242/246       238/244       238/242:238/246:242/244:244/246       10:10:9:8       1:1:1:1       0.961         uscCgi-210       339/339       33/342       33/39:339/342       23:16       1:1       0.262         Panel 3       ucdCg-170       null/null       null/136       null/136:null/null       17:21       1:1       0.516         ucdCg-199       285/285       285/288       285/285:285/288       17:21       1:1       0.543         ucdCg-152       256/256       256/null       256/256/null       23:17       1:1       0.343         ucdCg-152       2			$otg1a0_0139_G12$	193/193	193/195	193/193:193/195 262/mull/262/260/mull/260/260/260	19:17	1.1.1.1	0.739
9       Panel 1       ucdCg-120       170/172       170/172       170/172:172/172       9:23:8       1:2:1       0.622         ucdCg-198       261/261       261/264       261/261:261/264       17:23       1:1       0.343         ucdCg-117       294/294       294/302       294/294:294/302       14:26       1:1       0.058         Panel 2       Crgi3       171/183       171/173       171/171:171/183:183/183       8:23:9       1:2:1       0.622         ucdCg-146       242/246       238/244       238/242:238/246:242/244:244/246       10:10:9:8       1:1:1:1       0.961         uscCgi-210       339/339       333/342       333/339:339/342       23:16       1:1       0.262         Panel 3       ucdCg-170       null/null       null/136       null/136:null/null       17:21       1:1       0.516         ucdCg-156       183/183       183/187       183/183/187       17:21       1:1       0.516         ucdGg-0007_B07       299/299       285/285       285/285/288       17:21       1:1       0.206         Crgi4       256/256       256/null       256/256/256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299			ucucg-200	IIuII/209	203/209	203/11011.203/209.11011/209.209/209	10.8.12.9	1.1.1.1	0.820
ucdCg-198       261/261       261/261/264       261/261/264       17:23       1:1       0.343         ucdCg-117       294/294       294/302       294/294:294/302       14:26       1:1       0.058         Panel 2       Crgi3       171/183       171/183       171/171:171/183:183/183       8:23:9       1:2:1       0.622         ucdCg-146       242/246       238/244       238/242:238/246:242/244:244/246       10:10:9:8       1:1:1:1       0.961         uscCgi-210       339/339       333/342       333/399:339/342       23:16       1:1       0.262         Panel 3       ucdCg-170       null/null       null/136       null/136:null/null       17:21       1:1       0.516         ucdCg-199       285/285       285/285       285/285/288       17:21       1:1       0.516         Panel 4       otgfa0_0129_E11       null/null       null/null:null/null       11       0.206         Crgi4       256/256       256/null       256/256/256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299       297/299       20:19       1:1       0.343         ucdCg-152       269/269       251/269       25:18       1:1       0.527 <td>9</td> <td>Panel 1</td> <td>ucdCg-120</td> <td>170/172</td> <td>170/172</td> <td>170/170:170/172:172/172</td> <td>9:23:8</td> <td>1:2:1</td> <td>0.622</td>	9	Panel 1	ucdCg-120	170/172	170/172	170/170:170/172:172/172	9:23:8	1:2:1	0.622
Panel 2       Crgi3       171/183       171/183       171/171:171/183:183/183       8:23:9       1:2:1       0.622         ucdCg-146       242/246       238/244       238/242:238/246:242/244:244/246       10:10:9:8       1:1:1:1       0.961         uscCgi-210       339/339       333/342       333/339:339/342       23:16       1:1       0.262         Panel 3       ucdCg-170       null/null       null/136       null/136:null/null       17:21       1:1       0.516         ucdCg-156       183/183       183/187       183/183:183/187       17:23       1:1       0.343         ucdCg-199       285/285       285/288       285/285:285/288       17:21       1:1       0.516         Panel 4       otgfa0_0129_E11       null/null       null/null:null/null       101/null       0.206         Crgi4       256/256       256/null       256/256/256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299       297/299       20:19       1:1       0.873         Panel 5       Cgri45       168/178       168/168/168/178:178/178       9:18:12       1:2:1       0.707         Cgri39       216/null       220/null       216/202:216/null:220/null:null/null			ucdCg-198	261/261	261/264	261/261:261/264	17:23	1:1	0.343
Panel 2       Crgi 3       1/1/183       1/111       0.061       0.0622         ucdCg-120       339/339       333/342       333/339/339/342       23:16       1:1       0.262         Panel 3       ucdCg-170       null/null       null/136       null/181       1/1/183       1/1/183       1/1/183       1/1       0.262         ucdCg-156       183/183       183/183       183/183       183/183       183/183       1/1       0.343       1/1       0.206         Crgi4       05fa0_0129_E11       null/null       null/null       null/null       1/1       1/1       0.206       0.19       1:1       0.343         otgfa0_000		D 10	ucdCg-117	294/294	294/302	294/294:294/302	14:26	1:1	0.058
ucdCg-146       242/246       238/242       238/242:238/246:242/244:244/246       10:10:9:8       11:1:1       0.961         uscCgi-210       339/339       333/342       333/339:339/342       23:16       1:1       0.262         Panel 3       ucdCg-170       null/null       null/136       null/136:null/null       17:21       1:1       0.516         ucdCg-156       183/183       183/187       183/183:183/187       17:23       1:1       0.343         ucdCg-199       285/285       285/288       285/285:285/288       17:21       1:1       0.516         Panel 4       otgfa0_0129_E11       null/null       null/null:null/null       10:10:11:83       16:24       1:1       0.206         Crgi4       256/256       256/null       256/256:256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299       297/299/299       20:19       1:1       0.873         Panel 5       Cgri45       168/178       168/178       168/168:168/178:178/178       9:18:12       1:2:1       0.707         Cgri39       216/null       220/null       216/220:216/null:220/null:nullnull       8:9:14:9       1:1:1:1       0.527         Panel 6       otgfa0_48293		Panel 2	Crgi3	171/183	171/183	171/171:171/183:183/183	8:23:9	1:2:1	0.622
Panel 3       ucdCg-170       null/null       null/136       null/136:null/null       17:21       1:1       0.262         Panel 3       ucdCg-170       null/null       null/136:null/null       17:21       1:1       0.516         ucdCg-156       183/183       183/187       183/183:183/187       17:23       1:1       0.343         ucdCg-199       285/285       285/288       285/285:285/288       17:21       1:1       0.516         Panel 4       otgfa0_0129_E11       null/null       null/null:null/null       11       0.206         Crgi4       256/256       256/null       256/256:256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299       297/299/299       20:19       1:1       0.873         Panel 5       Cgri45       168/178       168/178       168/178:178/178       9:18:12       1:2:1       0.707         Cgri39       216/null       220/null       216/220:216/null:220/null:null/null       8:9:14:9       1:1:1:1       0.527         Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/193:193/195:			ucdCg-146	242/246	238/244	238/242:238/246:242/244:244/246	10:10:9:8	1:1:1:1	0.961
Panel 3       ucdCg-170       null/136       null/138       null/138 <td< td=""><td></td><td>D</td><td>uscCgi-210</td><td>339/339</td><td>333/342</td><td>333/339:339/342</td><td>23:16</td><td>1:1</td><td>0.262</td></td<>		D	uscCgi-210	339/339	333/342	333/339:339/342	23:16	1:1	0.262
ucdCg-156       183/185       183/185       183/185       183/185/185/185/187       17/25       171       0.343         ucdCg-199       285/285       285/288       285/285/288       17:21       1:1       0.516         Panel 4       otgfa0_0129_E11       null/null       null/null:null/183       null/null:null/183       16:24       1:1       0.206         Crgi4       256/256       256/null       256/256:256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299       297/299:299/299       20:19       1:1       0.873         Panel 5       Cgri45       168/178       168/168/168/178:178/178       9:18:12       1:2:1       0.707         Cgri39       216/null       220/null       216/220:216/null:220/null:null/null       8:9:14:9       1:1:1:1       0.527         Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg-200       269/272       269/269       269/269/269/272:272/272       13:16:9       1:2:1       0.409 <td></td> <td>Panel 3</td> <td>ucdCg-170</td> <td>null/null</td> <td>null/130</td> <td>null/130:null/null</td> <td>17:21</td> <td>1.1</td> <td>0.510</td>		Panel 3	ucdCg-170	null/null	null/130	null/130:null/null	17:21	1.1	0.510
Panel 4       otgfa0_0129_E11       null/null       null/null:null/183       null/null:null/183       16:24       1:1       0.206         Crgi4       256/256       256/null       256/256:256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299       297/299:299/299       20:19       1:1       0.873         Panel 5       Cgri45       168/178       168/178       168/168:168/178:178/178       9:18:12       1:2:1       0.707         Cgri39       216/null       220/null       216/220:216/null:220/null:null/null       8:9:14:9       1:1:1:1       0.532         ucdCg-152       269/269       251/269       251/269:269/269       22:18       1:1       0.527         Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg-200       269/272       269/269       269/272       269/269:269/272:272/272       13:16-9       1:2:1       0.409			ucdCg-156	183/183	183/18/	183/183:183/187	17:23	1.1	0.343
Panel 4       otgrad_0125_E11       null/null       null/183       10.24       1.1       0.206         Crgi4       256/256       256/null       256/256:256/null       23:17       1:1       0.343         otgfa0_0007_B07       299/299       297/299:299/299       20:19       1:1       0.873         Panel 5       Cgri45       168/178       168/168:168/178:178/178       9:18:12       1:2:1       0.707         Cgri39       216/null       220/null       216/220:216/null:220/null:null/null       8:9:14:9       1:1:1:1       0.532         ucdCg-152       269/269       251/269       251/269:269/269       22:18       1:1       0.527         Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg-200       269/272       269/269:269/269:269/272:272/272       13:16-9       1:2:1       0.409		Donal 4	atafa0 0120 E11	203/203	203/200	203/203.203/200 pull/pull:pull/193	17.21	1.1	0.310
Crigrit       250/250       250/1011       250/250/250/1011       25.17       1.1       0.343         otgfa0_0007_B07       299/299       297/299       297/299/299/299       20:19       1:1       0.873         Panel 5       Cgri45       168/178       168/178       168/168:168/178:178/178       9:18:12       1:2:1       0.707         Cgri39       216/null       220/null       216/220:216/null:220/null:null/null       8:9:14:9       1:1:1:1       0.532         ucdCg-152       269/269       251/269       251/269/269       22:18       1:1       0.527         Panel 6       otgfa0_408293       140/152       140/148       140/140:148/140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg-200       269/272       269/269       269/272       269/269/272/272       13:16-9       1:2:1       0.409		r allel 4	Orgia	1111/11111 256/254	11011/183 256/mm11	101/1011.1011/103 256/256·256/mult	10.24 23.17	1.1 1.1	0.200
Panel 5       Cgri45       168/178       12:1       0.707         Cgri39       216/null       220/null       216/220:216/null:220/null:nullnull       8:9:14:9       1:1:1       0.532         ucdCg-152       269/269       251/269       251/269:269/269       22:18       1:1       0.527         Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg-200       269/272       269/272       269/272:272/272       13:16:9       1:2:1       0.409			otafan 0007 D07	200/200	207/200	250/250.250/Hull 207/200-200/200	20.10	1.1 1.1	0.545
Panel 5       Cgri39       216/null       220/null       216/220:216/null:220/null:null/null       8:9:14:9       1:1:11       0.532         ucdCg-152       269/269       251/269       251/269:269/269       22:18       1:1       0.527         Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg-200       269/272       269/269:269/269'272:272/272       13:16-9       1:2:1       0.409		Danal 5	Cori/5	277/299 168/170	2711299 168/170	<i>2311277.27712</i> 97 168/168·168/178·178/179	20.17	1.1 1·2·1	0.073
Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1       0.527         Panel 6       otgfa0_0139_G12       193/195       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg-200       269/272       269/272       269/269:269/269/272:272/272       13:16:9       1:2:1       0.409		ranel 3	Cari30	216/pull	$\frac{100/1/8}{220/mull}$	216/220-216/mill-220/mill-mill/mill	9.10.12 8·0·1 <i>1</i> ·0	1.2.1	0.707
Panel 6       otgfa0_408293       140/152       140/148       140/140:140/148:140/152:148/152       9:7:14:10       1:1:1:1       0.457         otgfa0_0139_G12       193/195       193/195       193/195:195/195       10:20:9       1:2:1       0.962         ucdCg=200       269/272       269/272       269/269:269/272:272/272       13:16:9       1:2:1       0.409			ucdCg-152	210/11ull 269/260	220/11ull 251/260	251/269·269/269	22.14.2	1.1.1.1	0.552
$\begin{array}{c} \text{otgfa0}\_(022)^2 & 16(122 - 16(110 - 16(110(110(110(110(110(110(110(110(110(1$		Panel 6	otgfa0 408293	140/152	140/148	140/140/140/148/140/152/148/152	9.7.14.10	1.1.1.1.1	0.457
$ucdC\sigma_{2}00$ 269/272 269/272 269/269·269/272 272/272 13·16·0 1·2·1 0.400		i unei 0	otgfa0_0139_G12	193/195	193/195	193/193/193/195/195/195	10.20.9	1.2.1	0.962
$a_{000}g_{-200} = 207/272/2007/272/2007/2007/2727272727272$			ucdCg-200	269/272	269/272	269/269:269/272:272/272	13:16:9	1:2:1	0.409

157

(to be continued)

1	1	5	8	

(	continued)	
۰.	continuca	

Family	Multiplex	Locus	Female	Male	Genotypes of progeny	Observed ratio	Expected ratio	p value
10	Panel 1	ucdCg-120	172/172	158/170	158/172:170/172	22:18	1:1	0.527
		ucdCg-198	null/null	243/null	243/null:null/null	20:18	1:1	0.746
		ucdCg-117	294/294	292/294	292/294:294/294	22:17	1:1	0.423
	Panel 2	Crgi3	171/183	171/183	171/171:171/183:183/183	7:20:13	1:2:1	0.407
		ucdCg-146	242/246	254/254	242/254:246/254	21:19	1:1	0.752
		uscCgi-210	339/345	339/339	339/339:339/345	17:23	1:1	0.343
	Panel 3	ucdCg-170	128/132	132/138	128/132:128/138:132/132:132/138	9:12:7:12	1:1:1:1	0.615
		ucdCg-156	181/189	189/189	181/189:189/189	26:14	1:1	0.058
		ucdCg-199	285/285	285/288	285/285:285/288	15:23	1:1	0.194
	Panel 4	otgfa0 0129 E11	171/175	175/183	171/175:171/183:175/175:175/183	15:10:8:7	1:1:1:1	0.284
		Crgi4	238/256	238/256	238/238:238/256:256/256	7:20:13	1:2:1	0.407
		otgfa0 0007 B07	293/299	null/null	293/null:299/null	21:17	1:1	0.516
	Panel 5	Cgri45	176/178	178/178	176/178:178/178	23:17	1:1	0.343
		Cgri39	null/null	222/null	222/null:null/null	18:22	1:1	0.527
		ucdCg-152	269/269	269/278	269/269:269/278	17:23	1:1	0.343
	Panel 6	otgfa0_408293	null/140	134/148	134/null:134/140:null/148:140/148	13:12:5:10	1:1:1:1	0.284
		otgfa0 0139 G12	193/193	193/195	193/193:193/195	16:24	1:1	0.206
		ucdCg-200	269/269	269/284	269/269:269/284	15:25	1:1	0.114
11	Panel 1	ucdCg-120	162/170	170/172	162/170:162/172:170/170:170/172	3:14:13:10	1:1:1:1	0.060
	1 41101 1	ucdCg-198	255/null	243/null	243/255:243/null:255/null:null/null	9:7:8:16	1:1:1:1	0.172
		ucdCg-117	308/324	324/336	308/324:308/336:324/324:324/336	10:9:12:9	1:1:1:1	0.896
	Panel 2	Crgi3	183/185	183/189	183/183:183/185:183/189:185/189	19:8:7:6	1:1:1:1	0.012
		ucdCg-146	242/258	240/256	240/242:240/258:242/256:256/258	14:7:8:9	1:1:1:1	0.384
		uscCgi-210	339/345	339/339	339/339:339/345	22:18	1:1	0.527
	Panel 3	ucdCg-170	134/150	134/134	134/134:134/150	32:8	1:1	0.000
		ucdCg-156	189/193	185/185	185/189:185/193	18:22	1:1	0.527
		ucdCg-199	285/285	285/285	285/285	39	1	_
	Panel 4	otgfa0 0129 E11	177/181	165/175	165/177:165/181:175/177:175/181	16:8:4:9	1:1:1:1	0.044
		Crgi4	253/256	256/256	253/256:256/256	17:22	1:1	0.423
		otgfa0 0007 B07	289/297	295/297	289/295:289/297:295/297:297/297	14:12:2:12	1:1:1:1	0.032
	Panel 5	Cgri45	178/178	178/182	178/178:178/182	20:19	1:1	0.873
		Cgri39	214/216	218/220	214/218:214/220:216/218:216/220	12:7:9:12	1:1:1:1	0.615
		ucdCg-152	269/269	257/269	257/269:269/269	21:19	1:1	0.752
	Panel 6	otgfa0 408293	138/152	null/null	138/null:null/152	17:20	1:1	0.622
		otgfa0 0139 G12	193/193	187/193	187/193:193/193	20:19	1:1	0.873
		ucdCg-200	269/269	263/269	263/269:269/269	22:18	1:1	0.527
12	Panel 1	ucdCg-120	162/172	170/170	162/170-170/172	15.23	1.1	0 194
12	1 and 1	ucdCg-120	258/264	258/264	258/258:258/264:264/264	10.17.13	1.1	0.124
		ucdCg-117	320/322	300/302	300/320:300/322:302/320:302/322	8.9.12.10	1.2.1	0.826
	Panel 2	Croi3	183/183	183/189	183/183·183/189	20.20	1.1.1.1	1.000
	1 uner 2	ucdCg-146	234/242	234/256	234/234-234/242-234/256-242/256	11.11.4.14	1.1	0.145
		useCgi-210	339/345	333/339	333/339·333/345·339/339·339/345	8.10.13.9	1.1.1.1	0.706
	Panel 3	ucdCg-170	null/null	146/150	null/146:null/150	24.16	1.1.1.1	0.700
	1 uner 5	ucdCg-156	null/null	null/171	171/pull/pull	15.25	1.1	0.114
		ucdCg-199	270/270	270/282	270/270-270/282	14.26	1.1	0.058
	Panel 4	$0.0005^{-177}$	171/177	177/177	171/177.177/177	16.24	1.1	0.000
	i unel 4	Croid	238/256	238/256	238/238-238/256-256/256	8.19.13	1.2.1	0.200
		otgfa0 0007 R07	291/299	299/290	291/299·299/299	23.16	1.2.1	0.262
	Panel 5	Cori45	168/178	168/178	168/168/168/178/178/178	10.17.12	1.2.1	0.655
	i uner J	Ceri39	null/null	220/222	null/220:null/222	18:22	1.1	0 527
		ucdCg-152	269/260	269/260	269/269	39	1	-
	Panel 6	otofa0 408293	128/136	130/138	128/130 128/138 130/136 136/138	7.13.10.10	1·1·1·1	0.615
	1 41101 0	otgfa0_0139_G12	193/193	193/193	193/193	40	1	-
		ucdCg-200	260/263	263/263	260/263:263/263	21:18	1:1	0.631

Notes: Bolded *p* values indicate genotypic ratios that are not conform to Mendelian segregation.

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