

## **RNA-mediated paternal heredity of diet-induced obesity and metabolic disorders**

Valérie Grandjean<sup>1,2,3</sup>§, Sandra Fourré<sup>4</sup>, Diana Andrea Fernandes De Abreu<sup>5</sup>, Marie-Alix Derieppe<sup>1,2,3</sup>, Jean-Jacques Remy<sup>5</sup> and Minoo Rassoulzadegan<sup>1,2,3</sup>

<sup>1</sup> Inserm, U1091, Nice, F-06108; <sup>2</sup> CNRS, UMR7277, F-06108, France; <sup>3</sup> University of Nice-Sophia Antipolis, UFR Sciences, Nice, F-06108; <sup>4</sup> Institut de Pharmacologie Moléculaire et Cellulaire (IPMC), UMR 6079 CNRS-UNSA, Sophia Antipolis, France; <sup>5</sup> UMR Inra 1355, CNRS 7254, UNS, Sophia Antipolis, France.

§ Corresponding author:

University of Nice Sophia Antipolis (UNS)  
Faculty of Sciences, Parc Valrose,  
Institut de Biologie Valrose, iBV  
UMR CNRS 7277/Inserm 1091/University Nice Sophia Antipolis  
BP 2135  
06108 NICE CEDEX 2, FRANCE

Phone : +33 4 92 07 64 09  
Fax : +33 4 92 07 64 02

Email address: [grandjea@unice.fr](mailto:grandjea@unice.fr)

## Supplementary Information

- Supplementary Figure Legends
- 2 supplementary Figures (S1 through S2)
- 4 supplementary Tables (S1 through S4)
- Supplementary references

### Supplementary figure legends

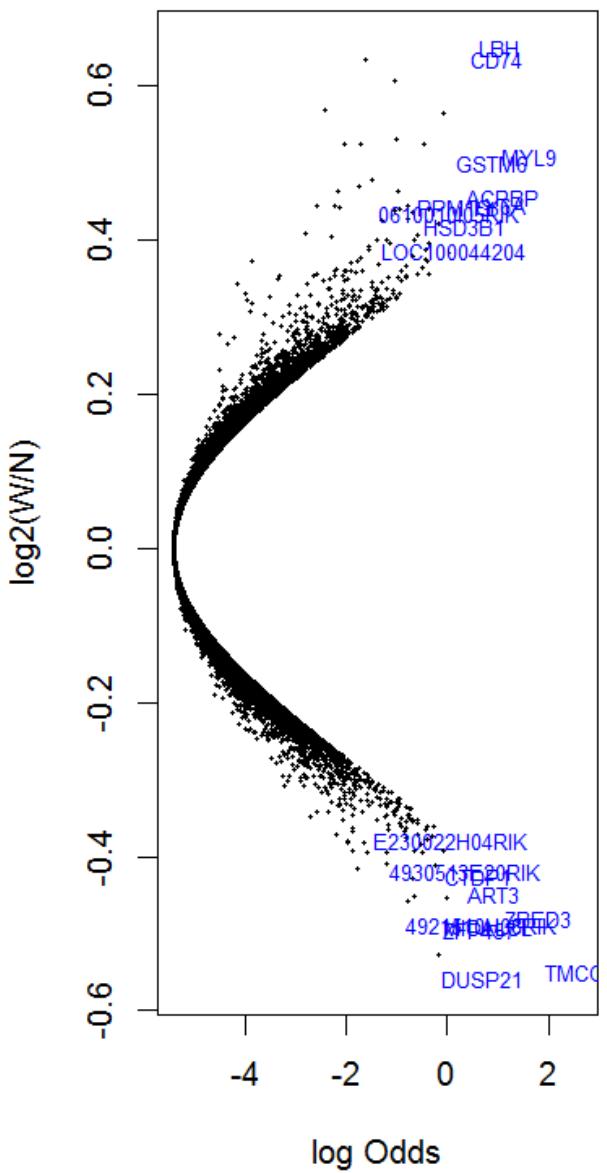
Supplementary Figure S1. **Volcano Plot.** The Log Odds (or B value) on the x-axis is the odds (or probability) that the gene is differentially expressed between Standard and Western-like Diet testis. A log Odds value of 0 corresponds to 50-50 chance that the gene is differentially expressed. The y-axis indicates the log<sub>2</sub> value of fold changes between the two conditions. B. MA Plot. The x-axis is the average expression level among the two conditions, indicating the basal expression level. And the y-axis is the fold change (log<sub>2</sub> scale), which indicates the difference level between the two. Each gene is represented on the plot as a single dot. Genes, up- or down-regulated in the Western-like Diet compared to the Standard Diet, correspond to blue spots and are listed in Table S2.

Supplementary Figure S2. **Spectrometric RNA quality checks.** RNAs prepared for microinjection were verified using Agilent Bioanalyser 2100 apparatus. The profiles indicate that both standard and western sperm RNA samples contain no apparent ribosomal RNA which are consistent with pure RNA sperm preparation.

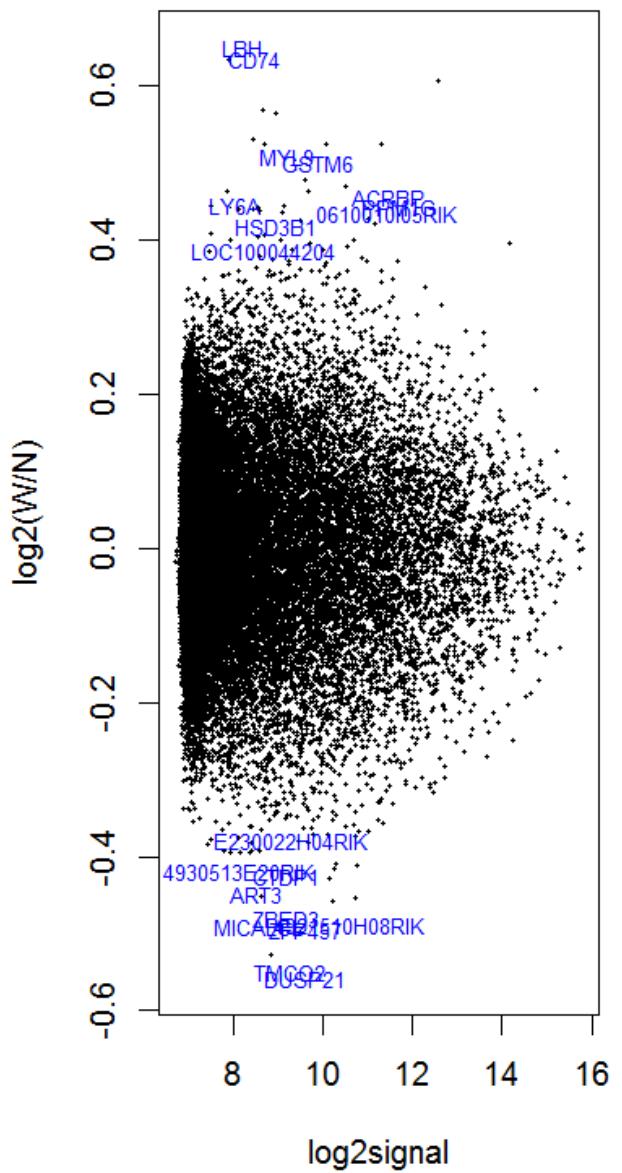
### Supplementary references

- 1 Roovers, E. F. *et al.* Piwi proteins and piRNAs in mammalian oocytes and early embryos. *Cell Rep* **10**, 2069-2082 (2015).
- 2 Rosenkranz, D. & Zischler, H. proTRAC--a software for probabilistic piRNA cluster detection, visualization and analysis. *BMC Bioinformatics* **13**, 5 (2012).

### Volcano Plot



### MA Plot



Supplementary Figure S1. Grandjean et al.

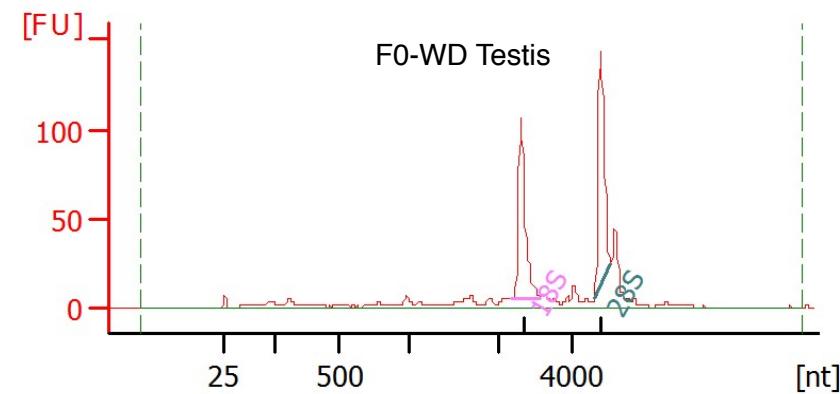
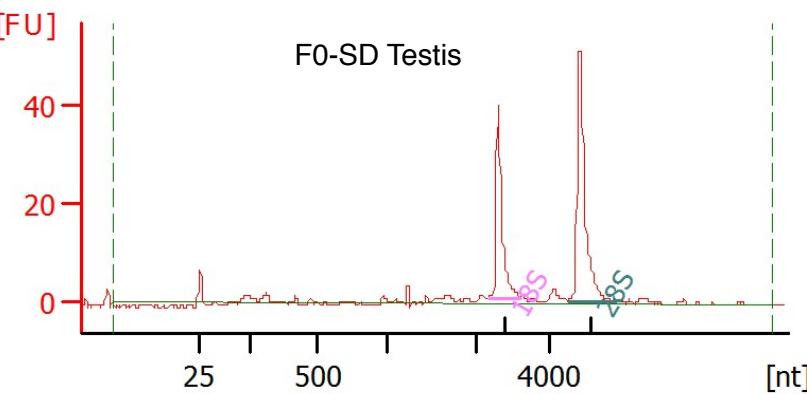
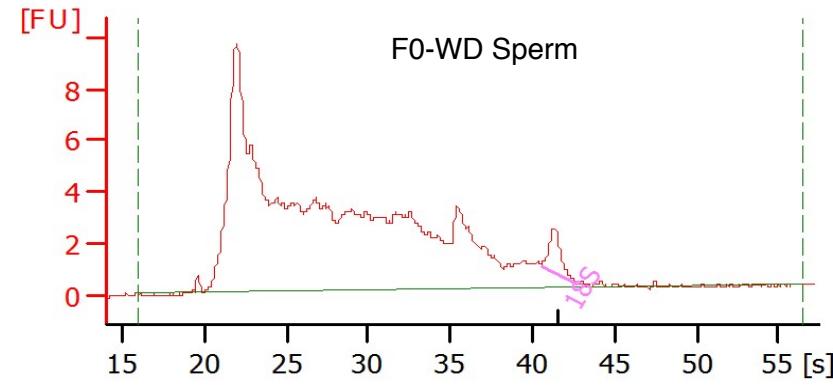
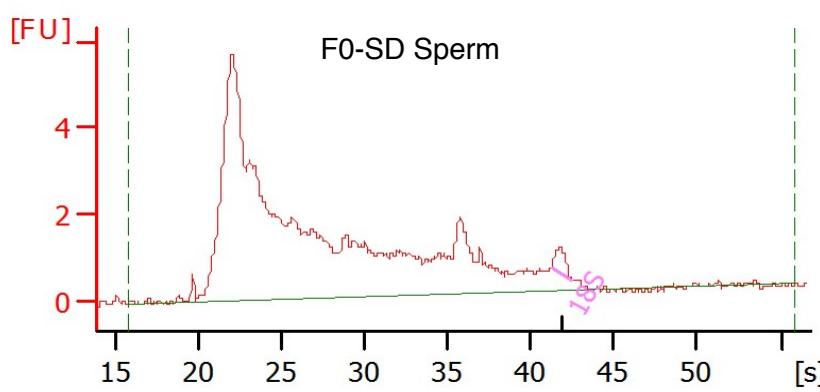
**a****b**

Table S1 Experimental diet nutritional composition

	Standard Diet <sup>a</sup>	Western Diet <sup>a</sup>
Carbohydrates (kcal%)	59,9 (of which sugar 3,2%)	46,1 (of which sugar 34%)
Proteins (kcal%)	16,1	15,3
Lipids (kcal%)	3,1	17,9
Caloric intake (kcal/kg)	2791	4035

<sup>a</sup>Standard Diet and Western Diet formulation according to SAFE

Supplementary Table S2. Genes up- or down-regulated in the Western Diet compared to the Standard Diet.

TargetID	IlluminaProbe	log2signal	log2(W/N)	p-value	N	N3	N4	W	W2	W4
DUSP21	6480196	9,58580985	-0,5573977	8,37E-05	712	1085,7	1242,9	658	540,8	621,6
TMCO2	1170377	9,25456911	-0,550455	3,91E-06	655,4	840,3	861,2	484,6	488,6	471,9
OTTMUSG00C	5130528	8,81610352	-0,5273555	0,00029025	524	688,3	510,6	420,7	285,6	384,8
ZFP457	6420563	9,62767069	-0,4944659	8,59E-05	877,5	1199,4	931,9	682,4	573,3	653,8
MICALCL	6520224	8,5827955	-0,4909786	6,86E-05	361,7	635,5	473,7	310,4	344,5	277,2
4921510H08R	4900639	10,5933185	-0,4878514	8,20E-05	1527,8	2663,4	1809,3	1242,1	1265,8	1178,4
ZBED3	1740161	9,20381296	-0,4792123	1,50E-05	683,5	724,2	793,4	474,7	488,1	467,7
PSMD6	6180088	10,2093418	-0,4584601	0,00072592	1081,1	1836,1	1619,9	979,6	1210,3	727,8
1700015E13R	3940408	10,722115	-0,4538694	0,0002383	1392,4	2593,9	2594,5	1247,9	1347	1485,1
LOC213411	4670632	8,60459717	-0,4523619	0,00059628	410,8	671,2	391,3	365,9	319,2	276,3
ART3	7000500	8,50666247	-0,4484799	5,82E-05	336,5	553,4	477,2	257	380,1	271,9
HIPK4	2350546	10,1310882	-0,427455	0,00062764	862,2	1829	1668,2	818	1018,2	910,5
CTDP1	520746	9,18156581	-0,4253574	9,21E-05	632,9	765,1	732,6	499,5	459,6	478,8
4930513E20R	460187	8,15378688	-0,4183476	0,00013285	281,1	394,2	364,3	222,5	234,1	254,7
SUGT1	580152	10,7660794	-0,4114791	0,00033175	1563	2793	2226,8	1361,5	1503,1	1402,8
NMT2	6450373	7,93415203	-0,3940891	0,00047263	226	384,4	285,8	182,3	217,7	219,4
MED7	6420156	7,76468368	-0,3931397	0,00059852	228,2	305,8	246,9	172	173,3	206,5
TMEM209	6420367	8,58318223	-0,3916577	0,00025476	350,9	551,1	506,8	290,8	355,8	319,8
A430037M23I	6060544	7,43603018	-0,3833058	0,00049556	167,2	216,7	239,6	135,2	164,9	142,5
E230022H04R	4880390	9,31165764	-0,379095	0,00020248	762	798,1	736,7	562,3	528,1	504,5
LOC10004783	6130202	7,50182954	-0,3769548	0,00041841	195	226,8	219,9	141,4	183,4	141,2
UCHL5IP	4570079	8,11939124	-0,3759743	0,00074363	257,9	411,7	338,2	230,8	252,2	221,8
RHBDL2	2970307	10,7146008	-0,3726464	0,00036209	1728,8	2221,6	2189,7	1423,9	1420,5	1349,5
ATP5SL	5270131	9,77181887	-0,3720594	0,00054409	710,8	1331,1	1234	566,3	758,5	891,9
SOX5	5050082	11,0081401	-0,3682525	0,00077092	2282,3	2958,8	2302,2	1946,2	1631,3	1547,4
ZFHX3	150605	7,76360962	-0,3649002	0,00043974	209,6	313,6	255,7	173,4	207,9	176,3
WDR35	5080072	9,55754216	-0,3620437	0,00074968	750,9	1039,5	946	607,2	598,8	695,1
KHSRP	4920593	8,39745294	-0,3616897	0,00084951	301,5	463,1	460,3	248,8	273,9	342,8
LOC10004067	2940673	10,51727777	-0,3612726	0,00041008	1714,1	1770,5	1824,1	1339,9	1079,4	1260,8
FANCL	6620240	8,37418001	-0,3608961	0,00034809	343,6	436	404,1	261	296,4	287,6
TIMP3	1400309	8,91589322	0,35602822	0,00054995	369,6	520,3	461,9	422	655,7	506,8
LAMB2	6840209	7,89516815	0,35652882	0,00038822	163,7	272,6	235,2	195,9	328,4	269,9
1700029F12Ri	1770504	11,2915265	0,35995174	0,00086015	2524,9	2248,3	2319,5	2832,7	2221,7	3040,8
AMHR2	3310739	8,52406641	0,36366088	0,00047346	307,7	411,2	305,2	339,2	470,2	397,5
CD151	1400630	10,0151647	0,36677298	0,00075086	798,1	1122,2	1005,9	817	1356,5	1219,8
SPTLC1	450048	9,21445583	0,37225431	0,00041237	447,6	612,9	605,5	588,8	733,2	607,9
ALDH1A2	6330098	8,86333918	0,37434794	0,00042977	384,4	425,1	478,2	413,6	549,1	564
MRPL4	4810100	8,56874317	0,37854329	0,00063127	317,7	350,1	378,3	323,6	428,2	511,4
GLOXD1	6480609	7,46384962	0,38515349	0,00020998	123,3	193,3	171,6	156,9	241,1	195
LOC10004420	3830048	8,67174533	0,38627035	0,00018334	279	489,5	380,3	323,4	581,1	466,2
LOC10004650	4610397	9,28995922	0,38718891	0,00042973	480,5	640,1	624,2	549,8	666,3	858,1
DEFB19	2030088	14,1621756	0,39594323	0,00039391	15501,3	20021,7	15849,5	16406,8	25160	18816,3
TGM2	7000187	9,06624757	0,40106689	0,00059245	340,1	607,5	576,7	396,6	875,1	565,4
ATP6V0D1	6290673	8,70114094	0,40676388	0,00053496	346,2	364	425,1	343,9	522	531,1
HSD3B1	360463	8,94033029	0,41807307	0,00013645	382	489,9	470,3	493,5	648,1	493,5
SLC25A5	5870092	11,1597012	0,42048999	0,0002995	1814,5	2316,3	2223,7	1865,2	3058,4	2653,4
EG668668	7570762	11,0204684	0,42660908	0,00069992	1603,9	1901	2268,5	1710,1	2876,5	2314
0610010I05RI	3990427	11,4512637	0,43483371	0,00020984	2889,8	2495,8	2352,3	2987,6	3011,7	3171,2
INHA	240739	8,5961062	0,43813215	0,00103142	348,1	306,1	390	348,8	529	430,5
PPM1G	3370546	11,6981224	0,44411152	0,00018829	3492,3	2588,7	3114,6	3632,6	3346,5	3964,7
LY6A	1690187	8,02745599	0,44528579	4,91E-05	185,2	297,7	225,1	218,1	405,5	280,8
ACRBP	2320017	11,4902449	0,45586514	4,42E-05	2786,5	2404,2	2708,5	3214	2993,7	3291,4

The experimental design is shown in Figure 1. Total RNAs from animal testes at four months old were prepared and subjected to analysis (Microarray Service CS3021 Illumina Gene Exp Process Ref: 338908 Qiagen). The resulting microarray data compared three males fed the WD diet (W, W2 and W4) to standards (N, N3 and N4). The RNA levels of WD-fed mice were compared to controls. Colon D ratios (W/S): colour ranged from green for lower expression to red for higher expression in WD.

Supplementary Table S3 List of differentially expressed piRNA

FR271924	piRNA	TGAGGAAGCATGAACACG/chr1	57410225	57410252	-1,6239251	0,00022246	0,00671165	207,020497	186,982214	190,982917	182,46599	303,380414	176,107161	173,123457	174,362848
FR233758	piRNA	TGGTACTGTAACGGGCC/chr1	94890676	94890701	1,61132844	0,00120302	0,01894317	4,40469142	7,10059042	3,74370426	7,53299959	4,624701043	4,31635199	3,39457758	7,4726935
FR203286	piRNA	TGAGCTTATTGCGGATTG/chr1	93452436	93452464	1,72419863	0,00512951	0,04807624	0,88093828	4,73372695	1,24790142	4,18499977	5,54964172	4,31635199	11,8810215	6,22724458
FR282027	piRNA	TTCITATGATTATTCAAGGAT/chr1	94893438	94893465	1,86448223	0,00514074	0,04810544	58,141267	31,9526569	62,395071	78,6779957	43,4721935	44,8900607	52,6159525	41,0998142
FR298866	piRNA	CTATAGATCTTGCGAAC/chr10	31317240	31317258	3,4642917	0,00110737	0,01811778	3,52375313	4,73372695	2,4958028	5,85999968	9,24940286	6,90616319	3,39457758	9,96359133
FR044731	piRNA	TAGATTTTATGCTATGTT/chr10	66159724	66159746	-1,65614241	4,90E-11	2,24E-07	61,6656798	86,3905168	87,3530993	65,2859964	136,891162	101,865907	87,4103727	83,4450774
FR344724	piRNA	TAATAGTCTGTGAGCTG/chr10	66149908	66149935	2,74388502	0,00137649	0,02063078	10,5712594	10,6508856	9,98321135	7,53299959	5,54964172	14,6755968	15,2755991	7,4726935
FR114471	piRNA	TAGCATATAAACTTAAAGAAC/chr10	62145467	62145496	1,51817421	0,0002788	0,00773078	45,8087907	61,5384503	36,1891412	45,1979975	42,547252	33,6675455	50,0700193	53,5543034
FR132075	piRNA	TCAGAGATCACAGAAAAAA/chr10	85214749	85214778	1,77849845	0,00307289	0,03437017	9,89032112	3,55029521	1,24790142	7,53299959	0,9249029	4,31635199	11,8810215	12,45444892
FR273679	piRNA	TACCGAACATATTTGGCT/chr10	62149748	62149788	1,55647618	2,85E-06	0,00048374	5,2863297	4,73372695	2,4958028	8,36999954	1,84988057	6,04289279	5,09186687	6,22724458
FR233265	piRNA	TGATCTCAGCTTGC/chr10	85227755	85227783	1,60849674	1,17E-05	0,00106387	20,2615803	35,5029521	27,4538312	30,1319984	11,0992834	26,7613823	14,4269547	18,6817337
FR157995	piRNA	TTTAAATTGAGCTGTGATCT/chr10	66159744	66159771	1,66363957	0,00027731	0,01401614	49,47040	46,1723269	45,3739953	46,2470143	56,1125759	49,2217347	54,9977523	
FR250874	piRNA	TTATGTTAAAGAAAAGAT/chr10	86039371	86039399	3,02E-05	0,00192624	22,7495558	450,887492	243,304770	30,178988	167,414192	251,211686	254,593319	21,971765	
FR009778	piRNA	TCTGTTGCCATTGAAAC/chr10	86035109	86035138	1,70755547	0,00072974	0,01404935	14,4521977	5,91751869	6,2395071	17,576599	3,69796115	10,3592448	7,63779956	16,1908359
FR252743	piRNA	TCATCTTGTGAACTCTCA/chr10	66160110	66160184	1,831149	0,00010763	0,0040978	9,69032112	4,73372695	9,98321135	6,69599964	5,54964172	5,17962239	11,8810215	13,6999381
FR199497	piRNA	TACAATTCAGAGAGAT/chr10	85227701	85227740	1,87548435	0,00073899	0,01411746	31,7137782	28,4026317	21,13243124	33,4799882	15,239849	25,8986286	27,3998762	
FR091791	piRNA	TATGATGAAATTGATCTGATC/chr10	85314401	85314421	1,92112303	0,00093354	0,01637549	40,9332543	37,8698153	33,6933938	29,2949984	12,941614	24,1715712	36,491709	22,4180805
FR084166	piRNA	TAAACATGAACTTAAAGAT/chr10	12713576	12713576	1,52665787	0,0011795	0,01879916	22,904395	31,2017113	26,205929	30,178988	10,1865907	77,22664	90,0951882	
FR223095	piRNA	TAGGTTAGTGTGACCTTCAG/chr10	94136855	94136885	3,41035636	0,00215823	0,01946883	77,525689	75,7396312	76,1219968	72,77449966	59,2688495	101,865907	77,22664	90,0951882
FR367717	piRNA	TNCGGCTTCGCTTCTTAAAG/chr11	103309271	103309900	1,-1,5199553	7,16E-05	0,00317644	101,19208	840,236534	93,928948	50,0942456	17,5615143	863,07135	91,1978581	
FR364835	piRNA	TTTATGAAACGGGTGTAA/chr11	5341184	5341212	2,07929478	1,80E-07	12,333136	7,10059042	8,73530993	4,18499977	15,7239849	11,2225152	11,0323771	12,45444892	
FR402585	piRNA	TACAGAAAGGTCACCTTCAG/chr11	107853721	107857860	1,94681965	0,00056062	0,00650602	29,0567129	17,810268	16,68669162	18,889891	129,49164	139,849805	145,118192	150,6993919
FR353048	piRNA	TTAACATTGTTGCTTGT/chr11	103031004	103031209	1,72432054	6,41E-05	0,00295945	59,9038033	55,6219179	71,1303809	64,448995	68,4485812	58,7023871	74,6807068	72,2360371
FR391061	piRNA	TGTCATCTGGTGGACCT/chr11	5431134	5431136	2,05077478	3,38E-06	0,00052523	10,355405	18,890450	12,990489	13,57534452	102,204737	85,9395752		
FR237942	piRNA	TGTTGATGAACTTAAAC/chr11	99682063	99682092	2,38997766	0,00019907	0,00624251	47,57067635	35,620989	33,908934	24,0844744	34,5300815	30,5111928	34,9098754	
FR254413	piRNA	TGTTGTTAGATGCCAA/chr11	99643109	99643139	1,-1,8845375	2,20E-06	0,00042326	96,9032112	60,3550186	69,8824795	71,1449961	34,2227906	50,9329535	59,4051077	39,8543653
FR075716	piRNA	TGTTGATGTCAGCTTAG/chr11	99655487	99655513	2,64E-05	0,00171783	23,1090863	35,5029521	22,462255	20,2247905	22,74879231	22,9133978	23,6353294		
FR151602	piRNA	TGAGGGCTTCGCTGATTC/chr11	99664018	99664043	1,62772695	5,57E-06	0,00071148	33,4756554	43,7869743	17,526915	30,1319984	31,4479667	70,7881727	30,5511928	32,3816718
FR304838	piRNA	TGCTGAGCTGGTCTGAC/chr11	99685219	99685221	1,6361737	0,000458432	0,04438342	49,9351018	36,6686389	22,46225527	41,0120978	11,0992834	25,0348415	29,7052288	31,1362229
FR171667	piRNA	TAATTTGGCTTGTGATC/chr11	99655047	99655075	1,51650121	8,42E-06	0,00078134	8,8093283	7,213778	11,7095042	1,2369507	9,0269995	15,388672	11,0323771	8,71814241
FR167053	piRNA	TAGCTTAACTTACAGAAG/chr11	99625873	99625902	1,83646858	4,87E-06	0,00067204	54,688648	343,195204	308,231651	36,95938	754,751274	491,200857	348,792847	34,007554
FR210227	piRNA	TAAGAATGAGCTTCTTAA/chr12	99642148	99642176	1,53794068	3,26E-06	0,00051397	15,8568891	4,73372695	6,2395071	12,5549993	10,1743432	9,49574348	10,183772	12,4544892
FR034787	piRNA	TTCTAACATAATGGCTC/chr12	99680832	99680889	1,53230054	0,00325081	0,03564797	28,190051	25,9895934	34,2227906	25,8986119	26,3079763	18,6817337		
FR301979	piRNA	TGAGGGCTTACATCTCTA/chr12	99655738	99655738	1,63268978	0,00009076	0,01607433	5,9411116	38,7869815	40,9704025	54,7096624	58,5899968	26,6731489	24,2808642	54,7997523
FR353828	piRNA	TAGTACCTTGTGCTTAACTTC/chr12	99678291	99678313	2,11333637	0,00461894	0,04468838	54,5742197	25,5472107	21,301713	9,9664227	17,57699	38,847492	29,3511935	19,5182211
FR227678	piRNA	TCTTAAATAATTAAGATG/chr12	99639268	99639314	2,38310158	2,99E-05	0,00191699	101,307903	101,1757529	82,3614937	100,439995	162,78949	131,217101	103,534616	91,9717709
FR131856	piRNA	TGAGAGCTAAGTGTG/chr12	53497240	53497240	1,7435858	0,0006689	0,01325702	36,999407	20,118395	37,4307426	46,0394997	32,8446258	14,6755968	36,491709	31,1362229
FR280787	piRNA	TCTCATGGTGTGATGAAA/chr12	51239801	51239829	1,74508862	0,0020118	0,00628708	82,8081986	40,2366791	48,6861553	83,699954	99,8935509	79,4208766	63,6483297	57,2905051
FR273779	piRNA	TGCTCATGGCTACATTC/chr12	25426870	25426889	1,66333733	3,12E-05	0,00195663	15,7433482	15,587983	20,9121268	10,200,9121268	67,202,9121268	12,08,62786		
FR158031	piRNA	TGATGATAAGTGTGCTG/chr12	74784792	74784792	1,74784792	0,00012308	0,00305835	12,00043821	10,7874792	10,71747178	11,6419663	79,7725729	12,4544892		
FR223089	piRNA	TGAGGATGATTTTCCTTC/chr12	50982929	50982955	1,6082656	6,10E-06	0,00246857	41,0650285	41,212,0542	42,102,0108	42,701,8529	30,23,083008	32,2484872	32,3816718	
FR204176	piRNA	TTGGTTTAAATAGGAGGG/chr15	51047579	51047579	5,08E-06	0,00062704	32,5947165	26,2059289	20,9249999	35,1773090	37,34,977309	37,12,06271	35,64,30646	24,9089783	
FR0478405	piRNA	TTAAATAGGAGGATTTAA/chr15	51039691	51040000	1,94233868	0,00016211	0,003734793	7,98244455	16,0585085	3,74,370423	2,51,009986	19,42,37456	24,5459337	31,73634675	
FR0414971	piRNA	TGAGATCAATTTAGTC/chr15	51090189	51091159	1,63571938	0,0010518	0,01766617	7,92844455	5,91715869	7,97480511	5,69,5499664	5,54964172	9,49597438	10,1837372	8,71814241
FR293825	piRNA	TAAGATGAAATTCTTGGAT/chr15	78497371	78498301	2,04034141	0,00065065	0,01311140	48,7055605	49,03854503	38,98,538203	12,92,443397	12,74,232379	11,42,732433	6,97,451393	
FR143411	piRNA	TGGCAGGAAAGAACTTAA/chr15	27451828	27451854	1,-1,85676534	0,02771172	0,0317314	95,14,13346	94,574539	91,0690836	49,84,29922	62,4455812	82,7379582	94,1995297	99,6359133
FR252303	piRNA	TTGAAATTTCAACAGTC/chr15	22655532	22655562	2,30134166	2,59E-05	0,00174249	57,2609884	40,2366791	72,372823	42,6869977	31,0777343	59,4051077	38,6089164	
FR336236	piRNA	TGAGGAAAGGTCAGGATTC/chr15	27451845	27451861	1,70185										

Name	Type	Seq	Chromosome	Start	End	log2FoldCharpval	padj	53,732,353	49,704,133	38,684,944	31,805,9983	63,820,8798	87,190,3102	37,403,534	48,572,5077	
FR117833	piRNA	TGAAATTTTACTTCTchr4	93960636	93960665	1,56409225	1,50E-05	0,00123349	77,5225689	112,426015	82,3614937	81,1889956	99,8935509	101,002637	100,140039	99,6359133	
FRO03397	piRNA	TACACGGAGCTAGGAAGTchr4	123572278	123572308	1,54456621	0,00498589	0,04704102	512,706081	452,070924	424,286482	616,686866	295,980892	338,40196	484,57595	368,652879	
FR073542	piRNA	TGAAGAGTATATGGCTGTchr4	93994476	93994503	1,95100341	0,00023887	0,00704873	4261,09848	4110,05842	3671,32597	3953,15078	4741,24391	4539,63902	4053,12563	3926,90043	
FR017976	piRNA	TGAACCTCTGTTGCAACchr4	93998075	93998101	2,26022225	5,10E-05	0,00258419	86,3319518	68,6390408	66,1387752	69,4709962	29,5980892	44,890067	78,9239288	72,2360371	
FR204403	piRNA	TAAAACTCGCTCGTGTTCchr4	123515094	123515122	2,65599798	0,00524801	0,04858791	72,2369392	75,7396312	73,6261837	86,2109953	85,0945063	71,6514431	72,983418	74,726935	
FR261079	piRNA	TGGAGCTCAGAGAACGchr5	150627666	150627686	-1,7171982	1,32E-05	0,00113806	19,3806422	15,3846126	19,9664227	19,250999	12,0242237	24,1715712	22,0647543	27,3998762	
FR048394	piRNA	TGAGTTATTGCTCTCTGchr5	113767220	113767247	-1,6407994	9,63E-06	0,00093818	233,486464	213,017113	299,496341	227,663988	261,758101	271,066905	213,858388	254,071579	
FR266385	piRNA	TACTGCTGAGTGAGGCCAchr5	113784228	113784251	1,5921705	0,00152384	0,02208573	35,2375313	22,4852054	9,98321135	31,8059983	24,0484474	23,3083008	33,0971114	16,1908359	
FR384675	piRNA	TGCCGTCGGTCTAGCAGchr5	150626164	150626167	1,51862795	0,00076396	0,01443281	69,5941244	50,8875647	41,1807468	51,8939972	48,0969849	61,2921983	63,5178947		
FR253835	piRNA	TGAAAATCTGTCGTCchr5	150616042	150616067	1,7347859	2,93E-06	0,00049242	206,139558	321,893433	304,487946	191,67299	453,22074	520,55205	359,825224	333,78039	
FR366488	piRNA	TGATAAGTATAATATCTchr5	113761250	113761278	1,41010016	0,00090095	0,01600307	42,0026103	42,6035425	31,1975355	40,1799978	21,2736266	34,5308159	42,4322198	47,3270588	
FR368487	piRNA	ACAAAAACCATGCAACGCTchr5	150614701	150614719	1,73320489	8,58E-07	0,00021529	41,4040993	20,1183395	29,946934	34,3169981	49,9467755	40,5730787	25,4593319	31,1362229	
FR279109	piRNA	TATCTATGAGTAGTACAGTchr5	150610004	150610033	1,78662377	7,03E-05	0,00313064	351,4792591	272,024985	223,7347358	21,1303808	70,3079962	126,716819	187,867595	266,47434	19,199009
FR397565	piRNA	TGGATTGACAAAGCTGCTchr5	150603701	150603731	1,57214033	0,00311688	0,03740109	290,709634	439,053175	460,475624	262,817986	716,82822	541,27054	405,652021	342,498452	
FR082597	piRNA	TTTTAAAAAAAGCTGCTTchr5	150619955	150619982	2,1915805	0,00049	0,01104423	7,04750627	8,28402216	7,48740783	6,65959964	7,3955229	6,90616319	9,33508835	7,4726935	
FR330410	piRNA	TTTGAACATGTCGTCACTchr5	130629699	130629727	2,85577798	0,00011705	0,004301	81,130164	123,076901	72,3782832	92,069995	110,992834	94,9647434	91,6535997	107,108607	
FR163800	piRNA	TCCCTACTGAAGGGCTTCchr6	85938104	85938133	-1,56742047	0,00446722	0,04366972	21,1425184	8,28402216	6,2359071	11,7179958	36,976115	16,4021376	36,491709	26,1544272	
FR080749	piRNA	TATTTCAAAGAACGTGCTGchr6	127764933	127764963	1,52905857	0,0026103	0,00749267	196,449237	218,456988	140,590924	196,825651	206,220588	222,933556			
FR386772	piRNA	TGAAAAGCAGAGCTTCchr6	127738854	127738914	1,58033596	0,00110124	0,018075	7,04750627	6,70095402	11,231112	8,36999954	12,0242237	7,76943358	11,0323771	13,6999381	
FR322734	piRNA	TAACAACTTAACTATTCTTchr6	128140803	12814083	1,77391627	6,59E-05	0,0030472	27,1839951	22,3374358	278,764989	1,7739551	4,7452799	64,4969741	49,8179566		
FR045462	piRNA	TATTGTTGCTCCAACTchr6	128397014	128397044	1,78898836	0,00044645	0,01040185	7,04750627	6,65088586	7,48740851	5,85899968	23,1235072	6,90616319	25,4593319	6,22724458	
FR024427	piRNA	TAGGGCTTAAGAAGTATTchr6	127768547	127768575	1,54610721	0,00088185	0,01578766	59,9038033	65,0887456	84,8572965	64,4489965	122,092118	75,967795	86,6517284	84,6905263	
FR167946	piRNA	TCGCTGAAAGGGCTTCAchr6	127768437	127768437	2,88163195	0,00057597	0,01208819	22,904955	16,5680422	8,28402216	9,98321135	22,5989988	10,1743432	12,949056	15,2755991	19,9271827
FR330918	piRNA	TGAAAAGAAGCTTCAchr6	127785030	127785030	3,28192866	0,002335	0,02889707	15,8568891	11,8343174	14,974817	12,5549993	19,423746	17,265408	19,5188211	16,1908359	
FR228320	piRNA	TGGAAGCAAGAACGATCTchr7	802665474	802665602	2,18025111	1,28E-08	3,89E-07	28,421485	28,4023617	31,2142341	38,5019979	23,1235072	15,5388672	22,0647543	13,6999381	
FR261537	piRNA	TGGATGCTAGGAGCTGGATchr7	80284272	80284288	-1,6381334	0,00096376	0,01676103	477,46855	488,283949	456,416863	486,719974	564,213575	566,030583	474,392217	393,561857	
FR056969	piRNA	TGAAAACAGCTCTGCCAchr7	707767671	70776798	1,52179475	0,00019907	0,00624251	20,2615805	21,3017713	18,7158213	17,576999	19,423746	24,1715712	11,8810215	12,4544892	
FR222727	piRNA	TAACTGTTGCTCCAACTchr7	80251632	80251660	1,57203505	0,00232091	0,02887422	28,1882695	28,4588896	28,1997102	185,603136	250,3509075	23,3898485			
FR075803	piRNA	TGCTGATAAGGCTTCAchr7	132473425	132473543	1,52407085	7,20E-05	0,00317797	303,42766	205,474261	29,112948	104,518252	134,670182	232,528564	205,499071		
FR061515	piRNA	TATTGATCTGAGTCAGAGAchr7	7073223	70732281	1,80583152	0,00020996	0,0064512	15,5712598	12,4521970	8,28402216	12,4790142	6,65999943	17,5738654	17,7891551	18,81714241	
FR193085	piRNA	TGCGCTATTGAGCTTCAchr7	70709651	70717597	1,57152064	0,00032402	0,00850443	156,807014	142,2110808	17,6978049	131,408993	67,5206409	91,506622	151,058702	181,8353542	
FR200839	piRNA	TGTTGATCATACTATCTGchr7	132473016	132473045	1,70516266	5,37E-05	0,0026746	50,2134882	36,6863839	38,684944	39,3389979	46,2470143	39,7104383	45,8267974	33,6271207	
FR291664	piRNA	TATTAGCAAGGAGCTTCTGchr7	80267592	80267620	1,56856656	2,98E-06	0,0049681	51,0944204	42,6035425	52,4118596	57,7529969	37,9225517	43,1635199	50,0700193	13,6405406	
FR249856	piRNA	TACCTTGTACTAGCTGGTchr7	60167576	60167603	1,62583526	0,00258959	0,02835732	32,5947516	28,4203617	25,9469886	11,0992834	10,3511203	23,7620431	22,4180805		
FR054584	piRNA	TATAAACCTAAATATACATchr7	802704455	80270485	1,56529113	0,00017597	0,01437486	28,1900251	30,48502102	28,7017326	30,9689883	17,5738654	29,3511935	30,5511928	32,3816718	
FR218632	piRNA	TAACAGCTGAGGAACTTACchr7	80289514	80289542	1,61266666	0,00064521	0,01301031	73,9988150	101,7175129	91,4916056	73,6559964	52,715963	41,4369791	55,1618857	63,5178947	
FR083597	piRNA	TGCAAACCTTGCAGCTGTchr7	80963064	80963144	1,71714555	0,00195029	0,02627274	61,6655798	65,0887456	49,9160568	51,8939972	65,6707603	62,15546487	56,0105301	44,836161	
FR055834	piRNA	TGGTGTGCTAACATGAGTchr7	77040882	770408887	1,53465151	6,08E-05	0,00219633	621,06149	549,11236	550,324526	616,031966	407,794606	467,892556	378,4954	592,833684	
FR024255	piRNA	TAAACTTAAAGCTGAAACTchr7	77049250	77049281	1,62116474	3,73E-05	0,00217476	11,4521977	13,0177491	14,974817	9,2069946	14,7990464	12,949056	16,1242435	8,71814241	
FR231465	piRNA	TACTAGTTGTTGAGGAGGTchr7	80951882	80951911	1,62748798	0,00435334	0,04284869	125,574175	113,609447	136,021255	120,527993	62,8959395	76,8310654	96,7454611	104,617709	
FR236096	piRNA	TCAACAACTCTTGTGAGTGAchr7	77075454	77075480	1,56108945	0,00018364	0,00585876	28,1900251	48,8207012	28,7017326	30,9689883	17,5738654	29,3511935	30,5511928	32,3816718	
FR114359	piRNA	TCATTTGTTACATTGTCGCCchr7	77058421	77058479	1,60826799	5,81E-06	0,00072049	45,1722847	49,171514	45,1722849	73,3955229	12,949056	15,2755991	16,1908359		
FR094852	piRNA	TATAAACTGAGTCTGAGTchr7	80934661	80934690	1,86257392	0,00035593	0,0090278	9,69032112	13,0177491	9,98321135	12,5549993	21,2736266	18,1286784	15,2755991	16,1908359	
FR008425	piRNA	AAGGAAGAACCTTGTGAGchr7	77077202	77077205	4,14E-07	0,0014687	713,560003	737,277972	54,0850196	63,914966	399,5740240	529,184754	494,759684	646,387987		
FR002623	piRNA	TAATGGACCACTGGGGAGGAchr7	80283413	80283442	1,99707359	0,00345458	0,03649594	27,5739598	24,5802829	27,5435982	118,392357	238,26263	227,436698	235,3889845		
FR171485	piRNA	TCAATTAACTTAACTTATTchr7	80936708	80936734	2,31888384	0,00073929	0,01411746	1,7617687	1,7617687	1,7617687	13,7490942	10,1837327	11,2225152	5,09186637	3,73634675	
FR379582	piRNA	TGGGAGCTGGGAGGAGGAchr7	94716382	94716407	1,74732355	0,00013175	0,00468934	61,6655798	65,087456	48,8098709						

Table S4: Mapping of the deregulated piRNAs to known piRNA clusters

Chromosome localization	Start	End	Cluster number	Number of deregulated piRNA/cluster
chr1	57348009	57362762	9	1
chr1	91551282	91560929	22	1
chr1	92988215	93000921	23	2
chr10	85848012	85855029	88	1
chr10	94670068	94680641	93	1
chr10	127690863	127704362	96	1
chr10	62651034	62694021	69	2
chr10	86560003	86596028	89	2
chr10	85740002	85774027	86	3
chr10	66680002	66709815	70	4
chr11	107990084	108001964	167	1
chr11	5526240	5536022	103	2
chr11	103420011	103453008	162	2
chr12	98379001	98455979	204	13
chr13	53393064	53407849	226	1
chr14	24078000	24124942	248	1
chr14	24421041	24433017	250	1
chr14	44759007	44791890	255	1
chr14	44932114	44946021	256	1
chr15	73094010	73110057	276	1
chr15	79924089	79934896	287	1
chr15	83349097	83369988	299	1
chr15	74625035	74667908	279	3
chr15	78642001	78675022	283	3
chr15	59245061	59304022	275	6
chr17	22511012	22522028	340	1
chr17	66148680	66159006	372	1
chr17	66164005	66233002	373	3
chr17	27283000	27370953	350	6
chr18	67028034	67088022	389	8
chr19	37252052	37264978	403	1
chr2	127687043	127706875	443	1
chr2	151139086	151162029	456	1
chr2	151245426	151267020	457	2
chr2	151315256	151336029	458	3
chr2	151398016	151420600	459	3
chr2	92536004	92613016	430	11
chr3	20460000	20469958	494	1
chr3	124398138	124419933	520	1
chr4	57353369	57369005	535	1
chr4	62216001	62243018	538	1
chr4	123888001	123899426	556	1
chr4	123831081	123846028	555	2

chr4	94277004	94338846	540	6
chr5	130149032	130159006	633	1
chr5	113316068	113373001	614	3
chr5	149786048	149834611	657	7
chr6	85983003	85994796	685	1
chr6	128179025	128204765	709	1
chr6	128440015	128453028	710	1
chr6	127778004	127842026	708	5
chr7	52903534	52918016	737	1
chr7	125323006	125337723	758	3
chr7	73098005	73154023	740	7
chr7	73774005	73842029	741	8
chr7	69879006	69940023	739	10
chr8	27291000	27301030	773	1
chr8	37089005	37096684	775	1
chr8	110118003	110134528	803	1
chr8	92185128	92202847	794	3
chr9	44139170	44153876	832	1
chr9	54206007	54266025	840	9
chr9	67689001	67763015	849	10

97% deregulated piRNAs were mapped to known clusters using the piRNA cluster data base provided on the web site <http://www.smallrnagroup.uni-mainz.de><sup>1,2</sup>. Only piRNA clusters with deregulated piRNA are listed.