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Research Article

An overall evaluation of the Resistance (*R*) and Pathogenesis-Related (*PR*) superfamilies in soybean, as compared with *Medicago* and *Arabidopsis*

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Abstract

Plants have the ability to recognize and respond to a multitude of pathogens, resulting in a massive reprogramming of the plant to activate defense responses including Resistance (*R*) and Pathogenesis-Related (*PR*) genes. Abiotic stresses can also activate *PR* genes and enhance pathogen resistance, representing valuable genes for breeding purposes. The present work offers an overview of soybean *R* and *PR* genes present in the GENOSOJA (Brazilian Soybean Genome Consortium) platform, regarding their structure, abundance, evolution and role in the plant-pathogen metabolic pathway, as compared with *Medicago* and *Arabidopsis*. Searches revealed 3,065 *R* candidates (756 in Soybean, 1,142 in *Medicago* and 1,167 in *Arabidopsis*), and *PR* candidates matching to 1,261 sequences (310, 585 and 366 for the three species, respectively). The identified transcripts were also evaluated regarding their expression pattern in 65 libraries, showing prevalence in seeds and developing tissues. Upon consulting the SuperSAGE libraries, 1,072 *R* and 481 *PR* tags were identified in association with the different libraries. Multiple alignments were generated for *Xa21* and *PR-2* genes, allowing inferences about their evolution. The results revealed interesting insights regarding the variability and complexity of defense genes in soybean, as compared with *Medicago* and *Arabidopsis*.

Key words: pathogen response, biotic stress, bioinformatics, *Glycine max*, *Medicago truncatula*.

Introduction

In order to prevent the effects of pathogen attack, plants evolved the ability to recognize the threat and struggle against the invader as well as trigger an effective response (Bolton, 2009). One of the most important steps of this complex response lies in the detection of pathogen invaders by the plant, a step where *R* (Resistance) genes play a crucial role. This sensing involves the recognition of a pathogen gene product called avirulence (avr) factor by a correspondent *R* gene. The plant will be resistant and the pathogen growth and establishment will be impaired when both *avr* and *R* genes are compatible, leading to the so-called Hypersensitive Response (HR) that triggers diverse responses, including local cell death to impair spreading of the pathogen (Bonas and Anckerveken, 1999). Besides this local reaction, the HR activates a signal cascade – including hormones and *PR* (Pathogen Related) genes, among others – that are able to establish resistance against a spectrum of different pathogen classes, this corroborating observations made at the beginning of the last century that plants, as well as animals (Benko-Iseppon *et al.*, 2010), may be immunized against the attack a of given pathogen after infection by another pathogen (Chester, 1933).

Besides a local reaction, plants may also display the Systemic Acquired Resistance (SAR). The SAR pathway is also common in many non-compatible plant-pathogen interactions (Nurnberg and Brunner, 2002). As soon as the pathogenic agent is detected, the plant induces a complex set of signal molecules able to activate defense proteins that

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may have a direct antimicrobial effect, as in the case of Pathogenesis-Related (*PR*) genes (Durrant and Dong, 2004). Alternatively, they may induce the production of secondary metabolites that impair pathogen movement or growth within the plant tissues (Sparla *et al.*, 2004).

Resistance genes are generally classified into five different groups or classes, defined according to their conserved domains (CD) (Bent, 1996; Hammond-Kosack and Jones, 1997; Ellis and Jones, 2000). The first class is represented by the *HM1* gene of maize that encodes a reductase able to inactivate toxins produced by the fungus *Helminthosporium carbonum* (Joahal and Briggs, 1992). It is the only *R* gene class where conserved domains are absent. A second class is represented by the *Pto* gene from tomato that confers resistance against the bacterium *Pseudomonas syringae* pv. *tomato.* It is characterized by a serine/threonine-kinase (ser/thre-kinase) domain, able to interact with the *avrPto* gene (Tang *et al.*, 1999). This gene was also identified in other plants, such as *Arabidopsis thaliana*, *Phaseolus vulgaris* (Melotto *et al.*, 2004), eucalyptus (Barbosa-da-Silva *et al.*, 2005) and sugarcane (Wanderley-Nogueira *et al.*, 2007).

The third class is represented by genes bearing two domains, viz. LRR (*Leucine Rich Repeats*) and NBS (*Nucleotide Binding Site*) (Liu *et al.*, 2004). This is the case of the *Rpm1* and *Rps2* genes from *A. thaliana*, the *N* gene from tobacco, *L6* from flax, *Prf* from tomato and *Rpg1* from soybean also found in common bean and faba bean (Mindrinos *et al.*, 1994; Lawrence *et al.*, 1995; Salmeron *et al.*, 1996; Ashfield *et al.*, 2003). The fourth *R* gene class encodes a membrane-anchored protein composed of an extracellular LRR domain, a transmembrane region and a short intracellular tail in the C terminal. The *Cf* gene from tomato is an example of this class, conferring resistance against *Cladosporium fulvum* (Dixon *et al.*, 1996).

The *Xa21* gene from rice confers resistance to the bacteria *Xanthomonas oryzae* pv. *oryzae* and is a representative of the fifth class (Song *et al.*, 1995; Wang *et al.*, 1995). This gene encodes an extracellular LRR domain (similar to the *Cf* gene), as well as a ser/thre-kinase domain (similar to the *Pto* gene), suggesting an evolutionary connection among different classes in the genesis of plant *R* genes (Song *et al.*, 1997).

PR proteins comprise pathogen-induced proteins that are routinely classified into 17 families based on their biochemical and molecular biological properties, from PR-1 to PR-17 (van-Loon *et al.*, 2006). Similarities among sequences and serological or immunological properties form the basis of their classification (van-Loon *et al.*, 1999). Although most PR proteins are known to have antifungal activities, their active molecular mechanisms are not well understood except for PR-2 (β-glucanases) and PR3 (chitinases) (Kitajima and Sato, 1999). PR1 is the most abundantly accumulated protein after pathogen infection and its genes have been cloned in many plants, such as tobacco (Gaffney *et al.*, 1993), *A. thaliana* (Metzler *et al.*, 1991), tomato (Tornero *et al.*, 1997) and apple. Although its phytochemical functions are unknown in all these species, this gene class is nonetheless considered to be a typical SAR marker (Bonasera *et al.*, 2006). PR-5 is a thaumatin-like protein with high antifungal activity, being also expressed under cold stress in overwintering monocots where it exhibits antifreeze activities (Hon *et al.*, 1995, Atici and Nalbantolu, 2003, Griffith and Yaish, 2004). Other families like PR-8 (Glycosyl hydrolase), PR-9 (secretory peroxydase), PR-14 (lipid transfer proteins), PR-15 (oxalate oxydase) and PR-17 (basic secretory proteins) (Nanda *et al.*, 2010) have been well studied and are believed to be involved in plant defense responses, although their molecular mechanisms have yet to be determined (Bolton, 2009). Most *PR* genes are expressed at a basal level under normal growth conditions, but are rapidly induced after pathogen infection. It is worthy of note that several *PR* genes are also regulated during development, leaf senescence and pollen maturation, as well as by environmental factors, such as osmotic, cold and light stress (Zeier *et al.*, 2004).

Soybean (*Glycine max*) is a globally important crop, providing oil and at least twice as much protein per acre as any other major grain (Libault *et al.*, 2010). Economically, soybean is the most valuable source of protein and edible oil crop in the world and serves as a model for seed and other developmental processes (Cannon *et al.*, 2009).

The present evaluation offers an overview of the main available sequences regarding plant-pathogen interaction of the *R* and *PR* classes in the soybean transcriptome, here compared with data available from *Arabidopsis* and *Medicago*, providing insights on the expression of such sequences in different tissues and inferring as to how these genes may have behaved over the course of evolution.

Material and Methods

Search and screening for R and PR genes in soybean, *Medicago* and *Arabidopsis* databases

For this purpose 59 proteins that play important roles in plant defense response were selected as seed sequences. The selected protein sequences were related to the 42 *R* and 17 *PR* gene classes described above. The *R* genes were previously compiled by Barbosa-da-Silva *et al.* (2005) and Wanderley-Nogueira *et al.* (2007), and *PR* seed sequences are available in Table S1 (Supplementary Material). All 59 seed sequences regarded full cDNAs that were obtained from the NCBI database and conceptually translated to improve search strategies.

For the identification of these gene analogs in soybean, *Medicago* and *Arabidopsis* transcriptomes, tBLASTx alignments were carried out against three platforms: GENOSOJA (The Brazilian Soybean Genome Consortium), TIGR (The Institute for Genomic Research) and

TAIR (The Arabidopsis Information Resource), using $1e^{-05}$ as the cut-off value.

Obtained clusters were annotated and analyzed for score, e-values, sequence size and presence of conserved domains, as shown in Table 1. For this purpose all clusters were translated using the TRANSLATE tool of Expasy and screened for conserved motifs with the aid of the rps-BLAST CD-search tool (Altschul *et al.*, 1990). The best match for each gene in each studied species was submitted to a BLASTx alignment in NCBI GenBank in an effort to confirm their putative function.

In a second manual analysis redundancies, *i.e.* clusters that matched more than one gene due to common domains, were eliminated. For this purpose, clusters matching each query sequence were annotated on a local database (called 'non-redundant').

The third step of the analysis aimed at comparing the number of *R* and *PR* candidate sequences obtained after the tBLASTn searches against the soybean, *Arabidopsis* and *Medicago* databases by direct counting of non-redundant clusters for each one of the 59 genes studied.

Phylogenetic analysis

Aiming to analyze the relationships among these genes, some *R* and *PR* gene candidates were selected from all three studied species for an evolutionary analysis using the maximum parsimony method and bootstrap function with 5,000 replicates. For this purpose CLUSTALx alignments were submitted to the program MEGA (Molecular Evolutionary Genetic Analysis), Version 4 for Windows (Tamura *et al.*, 2007).

Studying syntenic regions among the soybean and *Medicago* genomes

Best matches for all selected soybean genes were aligned against the *M. truncatula* pseudogenome aiming to anchor the 59 soybean sequences in virtual chromosomes through the CVit-BLAST procedure implemented in the *Medicago* sequencing resource website. BLAST algorithm parameters (score, e-value and percentage of identity) were adjusted to infer about the position of soybean sequences along the *Medicago* virtual chromosomes.

In silico expression assay based on GENOSOJA EST sequences

A preliminary analysis of the prevalence regarding the 59 genes in the soybean libraries was verified by direct correlation of the read frequencies of each cluster in various GENOSOJA cDNA libraries. Information regarding the 65 libraries that constitute the GENOSOJA database is available on The Soybean Genome Project Website. For practical purposes we combined some libraries that comprised different stages of the same tissue/organ (for example, B01 and B02 are here referred to as "B"), resulting in a total of 16 libraries (**B**: vegetable buds of field grown plants; **C**: cotyledons; **EN**: endosperm; **EP**: epicotyls; **F**: flowers; **H**: hypocotyls; **LV**: leaves; **R**: roots; **SH**: germination shoots; **ST**: stems; **SO**: somatic embryos; **SC**: soybean submitted

Table 1 - Soybean clusters matching results for each procured *R* and *PR* gene. Showing number of matches for each seed-sequence, e-value, score, size in nucleotide (nt) and amino-acid (aa), presence of conserved domains and number of matches in soybean (S) *Medicago* (M) and *Arabidopsis* (A). Abbreviations: (c) = Complete; (i) = Incomplete.

Gene class	Features of soybean clusters						# Matches		
	Best match	e-value	Score	Size		Conserved domain (c/i)			
				(nt)	(aa)		S	M	A
PR1	Contig 5043	7e-47	181	498	165	SCP (c)	8	19	22
PR2	Contig 9520	1e-102	369	1047	348	Glyco-Hydro (c)	86	214	95
PR3	Contig 5557	4e-48	187	957	318	Chitinase (c)	7	21	15
PR4	Contig 10145	2e-67	250	636	211	Chitin binding/Barwin(c)	2	14	2
PR5	Contig 29866	5e-60	226	1041	345	Thaumatin (c)	21	36	29
PR6	Contig 5043	1e-46	181	495	164	SCP (c)	11	17	23
PR7	Contig 66	5e-141	481	2283	760	Peptidase/Subtilisin (c)	82	97	50
PR8	Contig 14006	4e-89	232	894	297	Hevamine (c)	11	22	1
PR9	Contig 1796	1e-120	428	978	325	Secretory peroxidase(c)	31	46	66
PR10	Contig 4865	6e-26	112	410	160	Bet v 1(c)	18	18	34
PR11	Contig 5806	9e-79	289	1098	365	Plant chitinase class V (c)	1	11	9
PR12	Contig 13869	1e-09	58	291	96	Gamma-thionin (i)	1	15	8
PR13	No match	-	-	-	-	-	-	-	4
PR14	Contig 13114	6e-18	86	357	118	Lipid-transfer protein (c)	18	36	16
PR15	SJ01-E1-UK1-089-G01-UC.F	1e-48	188	660	219	Cupin2 (c)	27	47	37

Table 1 (cont.)

Gene class	Features of soybean clusters						# Matches		
	Best match	e-value	Score	Size		Conserved domain (c/i)			
				(nt)	(aa)		S	M	A
PR16	Contig 13716	2e-59	223	666	221	Cupin2 (c)	27	51	37
PR17	Contig 25189	2e-73	271	678	225	Basic secretory proteins (c)	2	1	5
Pto	Contig 5707	2e-143	505	2502	833	Ser-Thre Kinase (i)	238	239	248
Prf	Contig 5666	4e-34	142	2736	920	P-loop NTPase domain (c)	5	25	49
Pti4	SJ05-E1-S06-021-E06-UC.F	6e-33	136	825	274	DNA-binding domain (c)	89	90	119
Pti5	Contig 25338	6e-45	176	645	214	DNA-binding domain (c)	70	70	89
Pti1	SJ05-E1-UK1-024-H07-UC.F	2e-33	138	759	252	DNA-binding domain (c)	104	112	138
Pti6	Contig 10050	2e-146	514	1086	361	Tyr Kinase (i)	248	249	249
RAR1	Contig 27196	1e-76	281	672	223	CHORD superfamily (c)	1	2	1
RIN4	Contig 20845	7e-25	109	741	246	AvrRpt-cleavage (c)	2	8	1
RPM1	Contig 25089	5e-29	125	2781	926	P-loop NTPase-LRR (c)	14	73	90
RPS2	SJ01-E1-L06-046-G05-UC.F	7e-10	62	2538	845	P-loop NTPase-LRR (c)	4	36	90
PBS1	Contig 26006	3e-132	467	1152	383	Protein Kinase (c)	239	247	251
RPS5	Contig 10273	1e-17	87	1941	646	P-loop NTPase-LRR (c)	5	36	65
MLA10	SJ18-P1-S12-046-B20-UC.F	4e-07	51	913	305	P-loop NTPase-LRR (c)	0	21	30
L6	Contig 16939	5e-55	210	3198	1065	TIR-P-loop-LRR (c)	24	123	171
RRS1	Contig 14438	1e-30	107	2211	736	P-loop NTPase-LRR (c)	102	142	239
RPS4	Contig 16939	1e-35	148	3198	1065	TIR-P-loop-LRR (c)	50	198	226
Xa1	Contig 5507	5e-63	238	3609	1202	P-loop NTPase-LRR (c)	17	108	91
Hrt	Contig 16939	3e-54	207	3198	1065	TIR-P-loop-LRR (c)	61	208	181
Mi1	Contig 12827	2e-08	58.2	2733	910	TIR-P-loop-LRR (c)	1	29	50
BS2	Contig 10273	3e-14	76	1941	646	P-loop NTPase-LRR (c)	9	68	135
GPA2	SJ14-E1-S07-021-C03-UC.F	1e-22	104	2733	910	P-loop NTPase-LRR (c)	10	50	123
RX1	Contig 5666	4e-39	159	2736	920	P-loop NTPase-LRR (c)	14	61	112
Pi-ta	SJ14-E1-S07-021-C03-UC.F	1e-23	107	2733	910	P-loop NTPase-LRR (c)	2	17	62
I2	Contig 5507	8e-64	241	3609	1202	P-loop NTPase-LRR (c)	22	109	108
RPP8	SJ14-E1-S07-021-C03-UC.F	3e-19	94	2733	910	P-loop NTPase-LRR (c)	11	71	129
HERO	SJ14-E1-S07-021-C03-UC.F	1e-08	58	2733	910	P-loop NTPase-LRR (c)	5	39	78
L6	no match	-	-	-	-	-	-	-	-
RPP13	SJ14-E1-S07-021-C03-UC.F	1e-23	107	2733	910	P-loop NTPase-LRR (c)	2	51	77
RP1	Contig 10273	2e-26	86	1941	646	P-loop NTP-ase (c)	14	71	69
N	Contig 16939	2e-51	198	3198	1065	TIR- P-loop-LRR (c)	64	196	171
P	Contig 20164	3e-11	64	585	194	Dirigent super family (c)	17	37	18
M	no match	-	-	-	-	-	-	-	-
WRKY25	Contig 3637	4e-65	244	1761	586	WRKY superfamily 2 (c)	68	52	77
WRKY33	Contig 3637	7e-78	287	1761	586	WRKY superfamily 1 (c)	71	58	85
WRKY29	SJ01-E1-L08-116-F02-UC.F	5e-21	97.4	768	255	WRKY superfamily 2 (c)	28	22	37
Cf2	Contig 17295	1e-71	267	3132	1043	Multiple LRR (c)	249	250	266
Cf4	Contig 14446	4e-40	162	2256	751	Multiple LRR (c)	116	208	249
Cf5	Contig 6299	1e-39	160	2955	984	Multiple LRR (c)	123	207	219
Cf9	Contig 14446	5e-53	204	2256	751	Multiple LRR (c)	107	188	267
Xa21	Contig 439	3e-69	259	2913	970	LRR-Kinase (c)	251	249	247
FLS2	Contig 6299	6e-66	233	2955	984	LRR-Kinase (c/i)	174	251	249
EFR	Contig 439	2e-59	227	2913	970	LRR-Kinase (c)	250	239	253

to drought; **LI**: leaves infected with Asian rust; **MJ**: soybean submitted to *Meloidogyne javanica*; **SD**: seeds and **UK**: unknown). To generate an overall picture of selected *R* and *PR* gene expression patterns in soybean, a hierarchical clustering approach (Eisen *et al.*, 1998) was applied using normalized data and a graphic representation constructed with the aid of the CLUSTER program. Dendrograms including both axes (using the weighted pair-group for each cluster and library) were generated with aid of the TreeView program (Page, 1996). In these graphics, light yellow means no expression and red indicates all degrees of expression.

In silico expression assay based on the GENOSOJA SuperSAGE libraries

R and *PR* candidates were also used to screen the six SuperSAGE libraries generated by the GENOSOJA consortium. For the drought experiment, four libraries were generated using roots of two contrasting soybean genotypes, viz. Embrapa-48 (tolerant) and BR-16 cultivar (susceptible), both submitted to dehydration in the dark for 25 up to 150 min (all times bulked together), as compared with non-stressed controls. The other stressed library was generated using leaves of the resistant accession PI561356 inoculated with rust fungus and collected 12, 24 and 48 h post inoculation. For the composition of the pathogen-stressed library, equimolar amounts of the three inoculation times were used, as compared with the negative, non-inoculated control of the same genotype. The libraries were constructed at GenXPro GmbH (Frankfurt, Germany), essentially as described by Matsumura *et al.* (2008), and were subsequently sequenced via a SOLEXA platform.

Aiming to perform an overview of the GENOSOJA SuperSAGE data associated with *R* and *PR* genes, SuperSAGE tags were submitted to a BLASTn (maximum e-value $1e^{-05}$) against the database generated from three comparisons of the six available libraries (1-Embrapa-48, drought tolerant stressed *vs.* negative control; 2- BR-16, drought susceptible stressed *vs.* negative control; 3- PI561356 fungus resistant stressed *vs.* negative control). Each SuperSAGE tag was annotated considering the respective library comparison and also the respective aligned ESTs.

Results

Description and distribution of *R* and *PR* genes in soybean, *Medicago* and *Arabidopsis*

The tBLASTn alignment against the soybean transcriptome using the 59 known *R* and *PR* gene probes returned 1,066 non-redundant sequences from the contigs and singlets deposited in the GENOSOJA database. Among them, 700 represented contigs and 366 singlets, which together encompassed 26,653 reads. Regarding the tBLASTn searches in the *Medicago* transcriptome, a total of 1,727 sequences were positive matches. In *Arabidopsis,* 1,533 sequences returned matches after the same procedure.

A screening of *R* and *PR* genes in these three species resulted in the identification of 4,326 candidates, of which 3,065 were *R* and 1,261 *PR* gene candidates. A graphical representation regarding the prevalence of these sequences and how they are distributed among the soybean, *Medicago* and *Arabidopsis* transcriptomes is shown in Figure 1.

After analyzing all results it was observed that only one *PR* (*PR-13*) and two *R* genes (*L6* and *M*) were absent from the soybean transcriptome, while all the other 56 genes presented positive results in the tBLASTn searches. The same was denoted in the *Medicago* tBLASTn results for these three genes. Also in *Arabidopsis* no matches could be found for the two R genes *L6* and *M*, but four candidate sequences could be identified for the *PR-13* class, as shown in Table 1. A comparison of the distribution of non-redundant sequences in the three species revealed that the NBS-LRR family was the most frequent one in all cases, while the LRR-kinase class was the least represented in all studied organisms (Figure 2). Moreover, it was observed that while *Arabidopsis* presented a higher number of *R* gene candidates, *Medicago* matched the high number of *PR* genes. In both cases, soybean presented the lowest number of matches (Figure 3A).

The three most represented *R* and *PR* genes in all species were the same, with *Xa21*, *EFR* and *Pti6* representing *R* genes and *PR-2*, *PR-7* and *PR-9* representing *PR* genes.

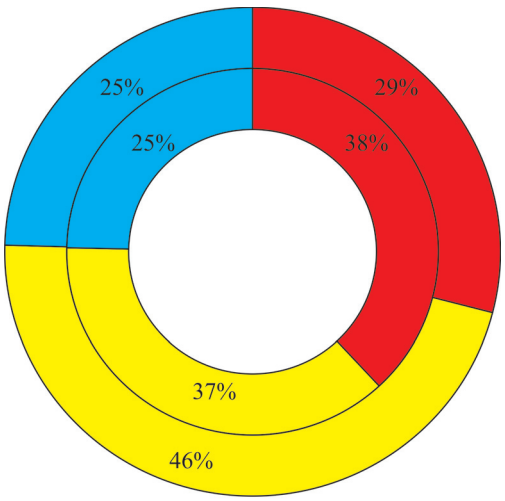

Figure 1 - *R* and *PR* genes encountered in soybean, *Arabidopsis* and *Medicago* transcriptomes. *R* genes are represented in the outer circle and *PR* genes in the inner circle for each species.

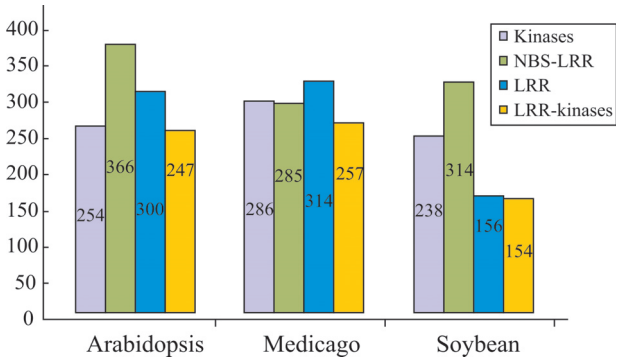

Figure 2 - Distribution of *R* gene families in soybean, *Arabidopsis* and *Medicago* in the four main *R* gene categories, considering their conserved domains. Column numbers correspond to the amount of non-redundant sequences for each class.

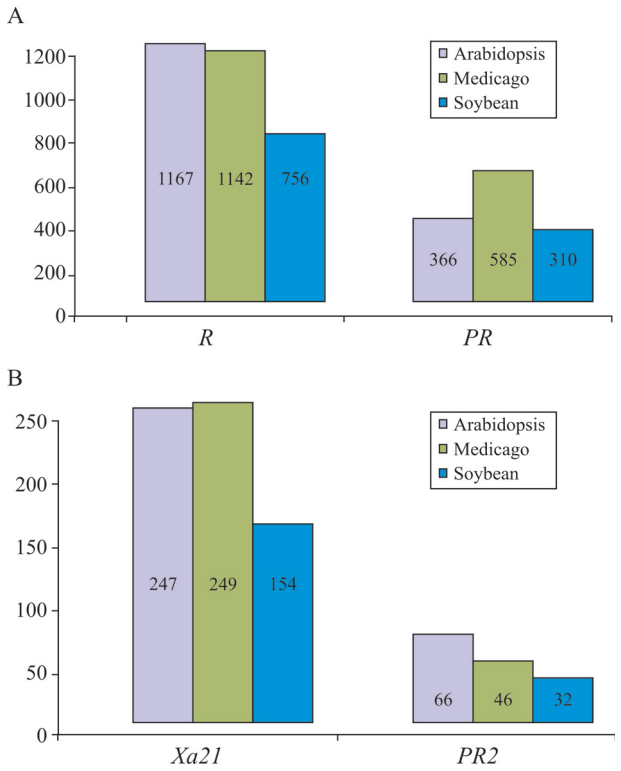

Figure 3 - Distribution of *R* and *PR* genes in soybean, *Medicago* and *Arabidopsis* (A). Distribution of *Xa21* and *PR-2* in soybean, *Medicago* and *Arabidopsis* (B). Numbers of matches for each gene category are shown inside the columns.

Due to this abundance, both *Xa21* and the *PR-2* genes were selected for the construction of a dendrogram and expression analysis. Matching of *Xa21* and *PR-2* candidates in soybean, *Medicago* and *Arabidopsis* did not follow a regular distribution pattern, since soybean presented fewer matches for both genes, and most of the *Xa21* candidate sequences were found in *Medicago*, whereas most *PR-2* candidates were found in *Arabidopsis* (Figure 3B).

Among the 310 *PR* genes of soybean only 40 matched with more than one seed sequence, all the others being exclusive to a given *PR* gene family. On the other hand, almost all *R* genes matched sequences that aligned with more than one probe, requiring manual sorting. Exceptions occurred only with respect to *RAR*, *RIN*, *P*, *WRKY29*, and *Xa21,* which aligned in most cases with exclusive sequences.

Phylogenetic analysis of *Xa21* and *PR-2* genes

Dendrograms generated for *Xa21* and *PR-2* genes using the soybean sequences and orthologs clearly divided dicots and monocots into distinct clades (Figure 4). In the *Xa21* analysis, the fern *Selaginella moellendorffii* was placed in a basal position from which the two branches representing monocots and dicots emerged (Figure 4A). The monocots group included members of the Poaceae family in one branch, with a bootstrap CI of 95%, associated in the same branch with the palm *Elaeis guineensis*. Regarding the dicot group, it was observed that both Fabaceae members (*G. max* and *M. truncatula*) were positioned together, while the other branch included members of the suborder Eurosidae I (*Vitis vinifera* and *Ricinus communis*), together with *A. thaliana,* a member of the Eurosidae II suborder.

Considering the *PR-2* dendrogram (Figure 4B), the grasses (Poaceae represented by rice and maize) occupied a basal position, from which a clade containing two monocots, ginger (*Zingiber officinale*) and banana (*Musa paradisiaca*), emerged. Moreover, a large clade containing all dicots was split into two subclades that behaved as merophyletic groups. For example, tobacco (*Nicotiana tabacum*) and coffee (*Coffea arabica*), members of the Asterid order, remained together, but potato (*Solanum tuberosum*) of the same order was positioned on another branch. Soybean and *Medicago* were also positioned in separate subclades.

Expression pattern of *R* (*Xa21*) and *PR* (*PR-2*) genes in the soybean transcriptome

From the 26,653 reads identified, an *in silico* expression assay was carried out considering transcripts from both genes *Xa21* (2,980 reads) and *PR-2* (1,099 reads). This allowed identifying their prevalence and normalizing their distribution among the tissues and conditions represented in the 65 different libraries. Graphic illustrations of these comparisons are available as Figures S1 and S2 (Supplementary Material).

The analysis of their expression pattern in soybean, obtained from normalized data, revealed that all libraries presented almost the same number of reads. The most representative library was from seed tissues (SD), presenting 10% of the identified reads. Expression in tissues from leaves (LV), roots (R) and flowers (F) presented similar expression, representing 9% of all reads in each tissue. The remaining tissues also presented significant expression (ranging from 5% to 8%), except in the case of libraries made from tissues submitted to the nematode *Meloidogyne javanica* (MJ), where no reads were identified.

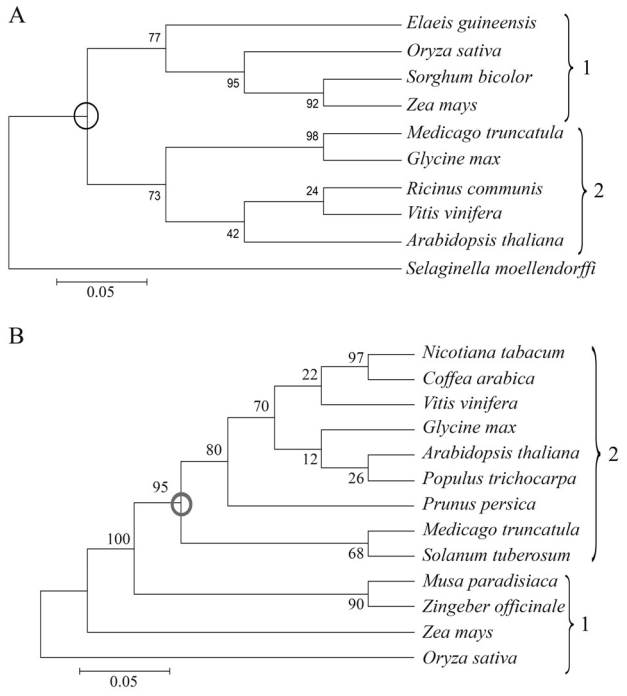

Figure 4 - Dendrograms generated after maximum parsimony analysis showing the relationships among selected plant species considering sequences of (A) *Xa21* and (B) *PR-2*. Keys in (1) represent monocots and in (2) dicots. *Xa21*: the circle on the root of A shows the divergence point between monocots and dicots. *PR-2:* the circle on the root of B shows an ancestor with a symplesiomorphic character. Numbers at the base of the branches denote bootstrap values and the bar represents the evolutionary scale.

Expression considering the SuperSAGE libraries

BLASTn results revealed that 944 soybean EST candidates aligned with 1,553 SuperSAGE tags when considering a cut-off value of $\leq e^{-5}$. Among all tags, 1,072 aligned with the *R* gene candidates from different classes, with emphasis on the NBS-LRR class. Additionally, 481 tags aligned with *PR* gene candidates, most of them with the *PR-9* secretory peroxidase family (Figure 5). Data concerning sequence-tag association are available as supplementary material (Tables S2, S3 and S4). The best results were obtained for comparison 1 (BR-16, drought susceptible stressed *vs.* negative control), which matched 613 non-redundant tags, while 465 were found for comparison 2 (Embrapa-48, drought tolerant stressed *vs.* negative control), and for comparison 3 (PI561356 fungus resistant stressed *vs.* negative control) 475 SuperTags were represented (Figure 5). It is noteworthy that many tags matched in more than one comparison.

Anchoring soybean *R* and *PR* genes in *Medicago* virtual chromosomes

The alignment of 59 soybean genes against the *Medicago* virtual chromosomes revealed 1,253 sites in all nine chromosomes, also including sub-telomeric regions

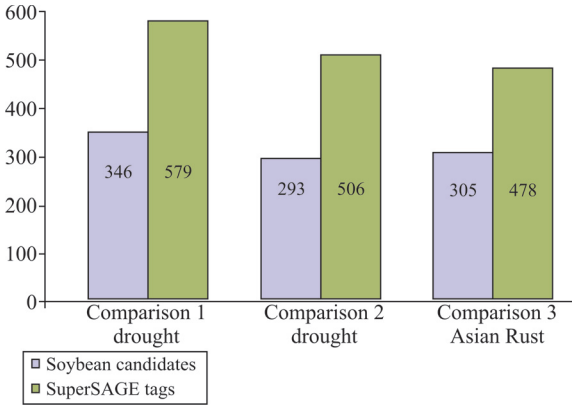

Figure 5 - Number of SuperSAGE tags matching soybean *R* and *PR* gene candidates from three different comparisons among the six libraries: 1-Embrapa-48, drought tolerant stressed *vs.* negative control; 2- BR-16, drought susceptible stressed *vs.* negative control; 3- PI561356 fungus resistant stressed with *Phakopsora pachyrhizi vs.* negative control.

(Figure 6). 58 genes presented similarities with distinct segments in the same chromosome or appeared twice in distinct chromosomes. Only the *PR-1* sequence anchored in an exclusive chromosome (2).

The highest number of anchored genes was found in chromosome 8, matching 32 of the 59 genes in 85 sites. On the other hand, chromosome 6 presented the lowest number of anchored genes (12). Nonetheless, this chromosome presented the highest number of duplications, matching 228 sites, most of them in tandem positions. Such tandem repetitions could be also observed in three sites of chromosome 3. The lowest gene density was observed in the long arm of chromosome 3. Syntenic regions were evident in chromosomes 2 and 4 (Figure 6).

Several sequences clustered along the genome, with some chromosomes rich in resistance genes, especially chromosomes 2, 7, 8 and 9, with at least four distinct genes in very close positions. These blocks of genes always matched *R* genes, while *PR* genes generally appeared in the same chromosomes in distinct sites.

Discussion

The 1,066 soybean sequences resulting from tBLASTx alignments confirmed the excellent coverage that the existing GENOSOJA databank comprises, including the most important representatives from different gene families.

Legumes are plants known to be able to withstand many kinds of stresses, including rapid climate changes, drought tolerance, exposure to diseases and pests, water logging and flooding (Cannon *et al.*, 2009), which could explain the higher number of *PR* genes encountered in *Medicago* in comparison to *Arabidopsis*, since these families of genes can be activated by different kinds of biotic or abiotic stress (Glombitza *et al.*, 2004). The low number of *R* and *PR* gene candidates found in soybean is curious when

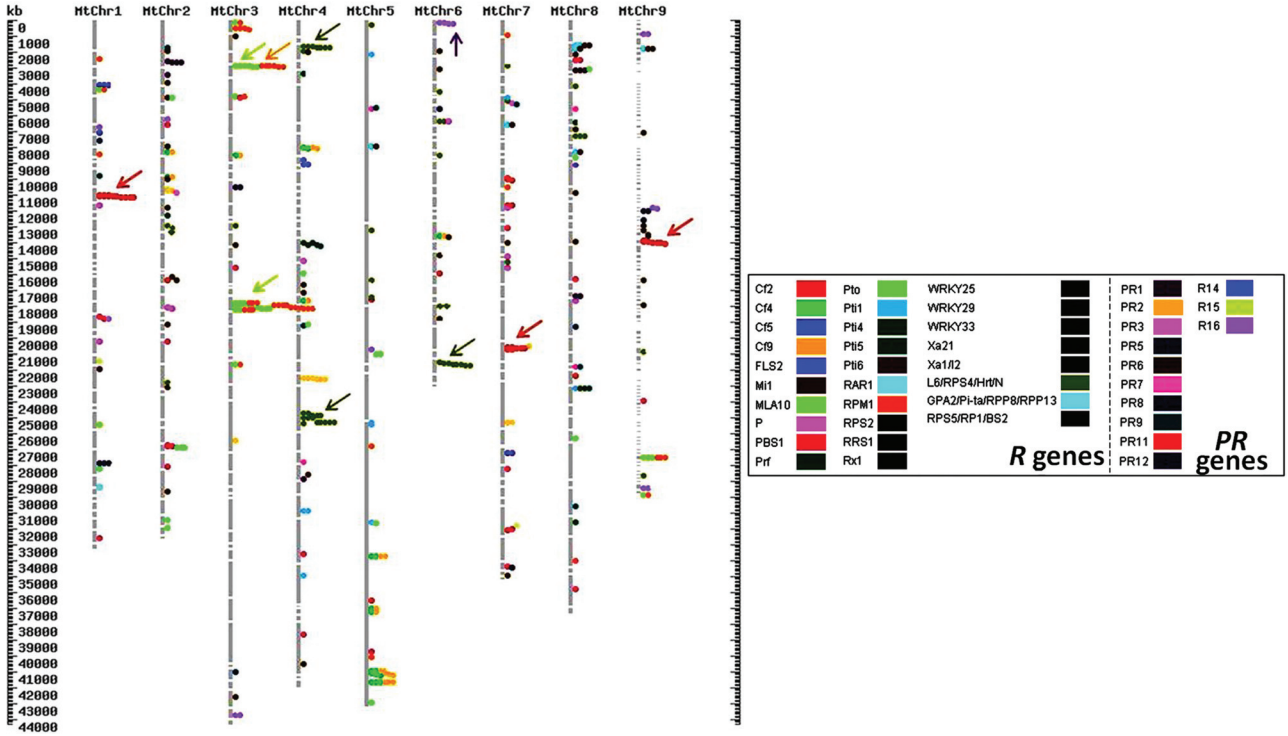

Figure 6 - Graphic representation of soybean *R* and *PR* sequences positioned on *Medicago truncatula* chromosomes (MtChr) with the aid of the CVit-BLAST resource available at the website http://www.medicago.org/. Arrows indicate genes that appear in tandem repetitions.

compared to *Arabidopsis* and *Medicago*, since these have smaller genomes (157 Mb and 583 Mb respectively) than that of *G. max* (1,115 Mb). This may be due to the analyzed sample, which was restricted to expressed sequence tags, whereas the databases of both *Arabidopsis* and *Medicago* are larger. Previous studies on legumes showed that despite the relatively large difference in genome sizes of soybean and *Medicago*, gene densities are similar, indicating that a given *Medicago* region is likely to correspond well with two soybean regions (Mudge *et al.*, 2005). This leads us to believe that additional expression assays in soybean may reveal important genes that are expressed under very specific conditions.

The number of soybean clusters that aligned with more than one *R* gene seed sequence is not surprising. Similar results were observed in previous studies regarding *R* genes of eucalyptus (Barbosa-da-Silva *et al.*, 2005) and sugarcane (Wanderley-Nogueira *et al.*, 2007). This occurs due to the common domains shared by *R* genes, as for example the LRR domain that is present in the LRR, NBS-LRR and LRR-kinase gene families, facilitating alignments with more than one gene. This is rarer when considering *PR* gene categories that are more distinct in structure and function (Kitajima and Sato, 1999), as also observed herein. A higher number of sequences matching NBS-LRR families, when compared to other classes, was also reported by Barbosa-da-Silva *et al.* (2005) and Wanderley-Nogueira *et al.* (2007), confirming the general observation that most *R* genes are members of this class.

Dendrograms generated from these data revealed a similar picture in both gene classes selected (*Xa21* and *PR-2*). In the case of *Xa21*, the positioning of *Selaginella moellendorffii* as an outgroup was expected, since this species figures as a member of an ancient vascular plant lineage that first appeared 400 million years ago, and thus represents a basal node on the plant evolutionary tree (Weng *et al.*, 2008). The analysis of the *Xa21* orthologs from different species reflected their relationship according to classic taxonomy. Lilliopsida class (monocots) appeared as a monophyletic group uniting on the same branch *Oryza sativa*, *Zea mays* and *Sorghum bicolor,* which are all annual cereal grains of the Poaceae family, while the palm *Elaeis guineensis* (Arecaceae) was positioned on another branch. Considering the Magnoliopsida (dicots), the same occurred, since *Medicago* and soybean, both legumes and members of Fabaceae, appeared in a subclade, separated from the remaining species. *R* genes are considered fast evolving, due to their co-evolution with specific pathogens (Michelmore and Meyers, 1998). In the case of *Xa21* the most polymorphic region is its extracellular LRR domain, which is responsible for pathogen specificity (Ellis *et al.*, 2000), defining the relationships of the dendrogram presented here.

The *PR-2* dendrogram topology showed two main clades, as expected, monocots and dicots. The grouping of monocots followed the taxonomic relationship, segregating *Musa* and *Zingiber* (Zingiberales) from *Oryza* and *Zea* (Poaceae). It was possible to identify that a symplesiomorphic character united all dicots, reflecting their common origin. Moreover, considering the Magnoliopsida group, the evolutionary model of the *PR-2* class seemed to follow a synapomorphic pattern, leading to their diversification in different groups comprising families and orders, this probably reflecting divergent processes regarding this *PR* gene.

The studied organisms presented different centers of origin, habitats and cycles of life, as well as tolerance, resistance and sensitivity to diverse kinds of biotic and abiotic stresses. Nonetheless, from an overall perspective and considering the position of different species in the dendrograms, it is evident that both *Xa21* and *PR-2* pathways genes were present in a common ancestor of the angiosperms, since they appear relatively conserved in different plant groups.

Many *PR* genes are constitutively expressed in given plant tissues (Velazhahan and Muthukrishnan, 2003; Liu *et al.*, 2004), suggesting a link between biotic and abiotic stresses and indicating that at least some members of the PR proteins play important roles in plant development, besides their role in defense responses. This fact may explain why the expression of *PR-2* gene can be observed at a basal level in almost all tissues, as seen when considering their frequencies in the soybean libraries.

Studies carried out by Li *et al.* (2008) and Libault *et al.* (2010) revealed consistent differences in gene expression patterns among diverse tissues, especially between roots and aerial tissues, but also revealed similarities between expression levels in tissues such as flowers and leaves, corroborating our results. The most represented library was for seeds, including different development stages, which is not surprising, since previous evaluations also revealed that the soybean grain contained the vast majorities of expressed genes and regulatory sequences in the plant (Cannon *et al.*, 2009). In the case of the *PR-2* protein, it is interesting to note that previous evaluations carried out by Leubner-Metzger (2005) in tobacco suggest that this gene could play a role in seed germination. Furthermore, the expression of both genes was also increased in leaves, roots and flowers, confirming their prevalence in developing tissues.

As mentioned above, abiotic stress is able to trigger diverse plant responses. After an initial massive distribution of energy triggered by stress, a wide array of defense mechanisms is activated by *R* genes, inducing a signal cascade and increased *PR* gene transcription (Vergne *et al.*, 2010). This may justify the considerable amount of soybean SuperSAGE tags related to these genes among the three comparisons considered, with considerable representation in both biotic and abiotic (drought) conditions, as well as in the negative controls, with many tags represented in more than one treatment. The high number of tags that matched with BR-16 drought susceptible library *vs.* control could be explained by the ability of the plant to continue expressing genes related to systemic acquired resistance as a consequence of contact with any kind of previous stress, a crosstalk previously reported for other plants (Durrant and Dong, 2004; Kido *et al.*, 2011). Comparing the distribution between *R* and *PR* genes, both were representative with 1,072 tags matching *R* genes and 481 tags matching *PR* candidates, indicating that additional analytical efforts regarding the SuperSAGE candidates will reveal not only associations with specific situations, but also allelic differences important in the definition of biotic and abiotic stress responses.

Flowering plants originated approximately 200 million years ago (Wilkstrom *et al.*, 2001) and subsequently diverged into several lineages. Legumes are an old family believed to have originated approximately 54 Mya (Lavin *et al.*, 2005). Soybean and other papilionoid legumes show evidence of an older shared duplication and probably soybean underwent polyploidy 13 Mya (Shoemaker *et al.*, 2006). These duplications are widely evident, both in number of similar duplicated genes and in large areas of synteny between chromosomal regions. Previous evidence indicates extensive similarities in gene densities and distribution among soybean and *Medicago*, inferring that a given *Medicago* region is likely to correspond well with two soybean regions (Mudge *et al.*, 2005). This evidence suggests that *Medicago* could represent "a simplified draft" of the soybean gene distribution, making an evaluation regarding *R* and *PR* soybean ortholog distribution in this crop most desirable. Hence, it is not surprising that all identified soybean *R* and *PR* transcripts appeared anchored in 1,253 sites in all segments of *Medicago* virtual chromosomes.

The rich *R* gene regions found in chromosomes 2, 7, 8 and 9 confirm previous observations that most resistance genes reside in clusters (Kanazin *et al.*, 1996), as reported in maize (Dinesh-Kumar *et al.*, 1995), lettuce (Maisonneuve *et al.*, 1994), oat (Rayapati *et al.*, 1994) and flax (Ellis *et al.*, 1995). The formation of gene clusters is in general associated with a common ancestor, and the diversification of these genes is the result of duplication processes followed by diversification due to pathogen or environmental pressure.

Clustering of *R* genes corroborates the existing theory that a common genetic mechanism involving duplication has been responsible for the evolution and diversification of this gene superfamily (Hulbert *et al.*, 2001). The four clusters presented similarities with distinct segments in the same chromosome, probably reflecting tandem gene duplication mechanisms. Such duplicated copies tend to diverge by acquiring additional mutations and may specialize or

optimize to play slightly different roles (Alberts *et al.*, 2002).

Regarding the duplicated segments considering the entire genome, 58 genes could be identified in at least two distinct chromosomes. Unlike tandem duplications, repetitions in distinct chromosomes resulted from events of duplication followed by translocations and sequence divergence, also allowing functional diversification (Wendell, 2000; Thiel *et al.*, 2009). There is also evidence that transposition outbreaks could be activated by severe environmental biotic or abiotic stress.

Still regarding the duplication event analysis, a large in tandem repetition was evident in both chromosomes 3 and 6, represented by the genes *Xa1*/*I2* and *RRS1,* respectively. Previous reports suggested that once duplicated, genes in tandem repetitions may expand rapidly through events of unequal crossing over, since the character could confer advantage to the organism (Alberts *et al.*, 2002), in this case a higher diversity of genes associated with resistance and stress response. This evidence supports assumptions that future efforts regarding increased pathogen resistance may rely on biotechnological inferences that consider whole gene clusters naturally associated in neighboring positions, rather than isolated genes (Dafny-Yelin and Tzfira, 2007), as has been traditionally done.

In conclusion, the here identified sequences represent valuable resources for the soybean breeding program, allowing their use in biotechnological approaches, with emphasis on transgenes. They are also valuable for mapping purposes, considering the putative distribution here uncovered when considering available distribution of genes known from the *Medicago* genome.

Considering gene diversity revealed especially by the SuperSAGE approach, their association with specific responses to biotic or abiotic stress conditions may reveal important gene variants for germplasm screening in the search for new accessions useful for breeding purposes, especially in association with marker assisted selection (MAS), saving decades of laborious research.

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Internet Resources

Expert Protein Analysis System (Expasy), http://expasy.org.uk (August 18, 2010).

Medicago sequencing resource website, http://www.medicago.org (October 19, 2010).

The Arabidopsis Information Resource (TAIR), http://www.arabidopsis.org (September 1, 2010).

The Brazilian Soybean Genome Consortium (GENOSOJA), http://bioinfo03.ibi.unicamp.br/soja (August 8, 2010).

The Institute for Genomic Research (TIGR), http://plantta.jcvi.org (August 8, 2010).

Supplementary Material

The following online material is available for this article:

Figure S1 - *Xa21* expression profile in 16 different libraries from GENOSOJA.

Figure S2 - *PR-2* expression profile in 16 different libraries from GENOSOJA.

Table S1 - Accession number of reference *PR* genes used as seed sequences.

Table S2 - Number of SuperSAGE tags per comparison.

Table S3 - SuperSAGE tags that matched genes.

Table S4 - Number of tag repetitions in comparisons matching *R* and *PR* genes.

This material is available as part of the online article from http://www.scielo.br/gmb.

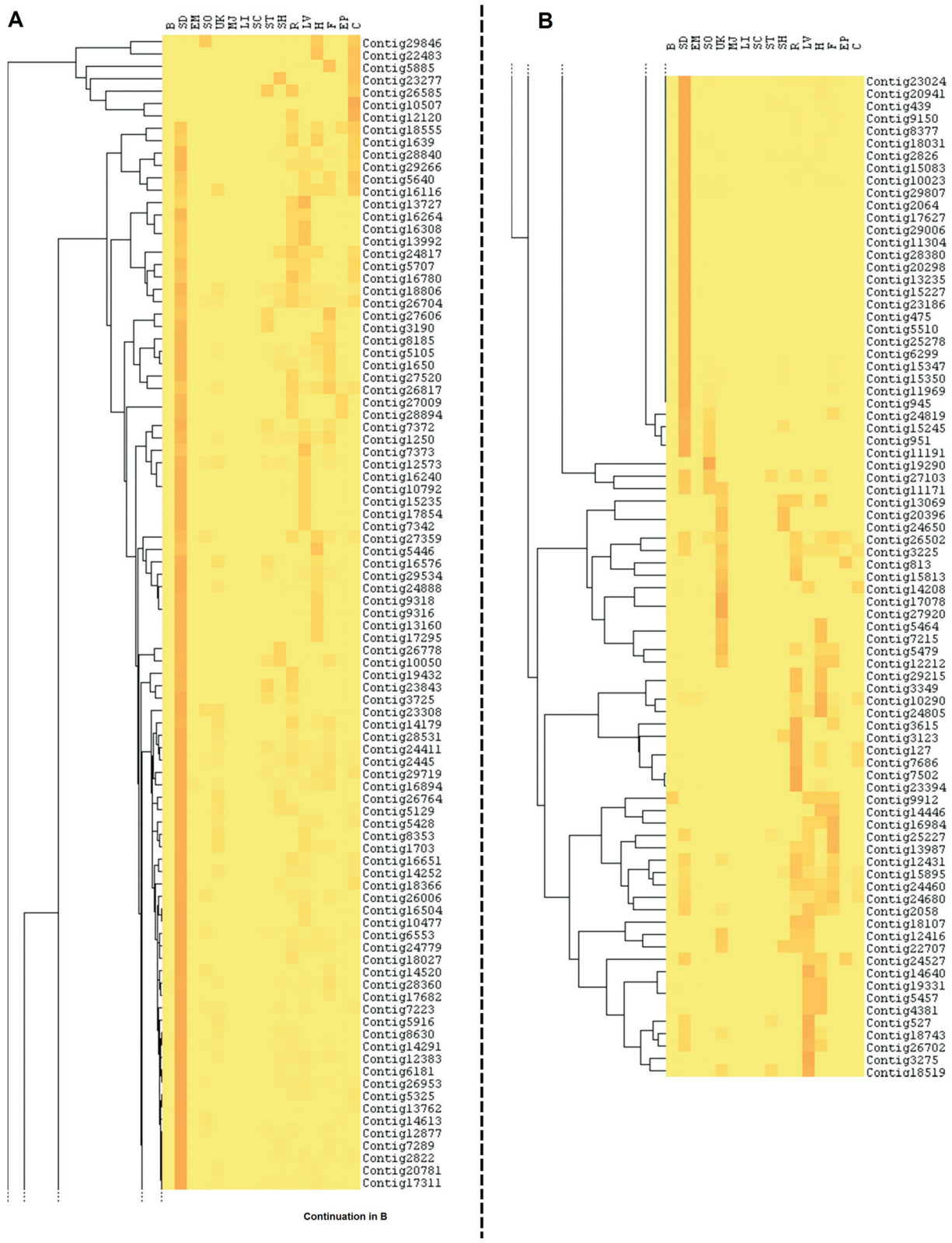

Figure S1 - *Xa21* expression profile in 16 different libraries from GENOSOJA.

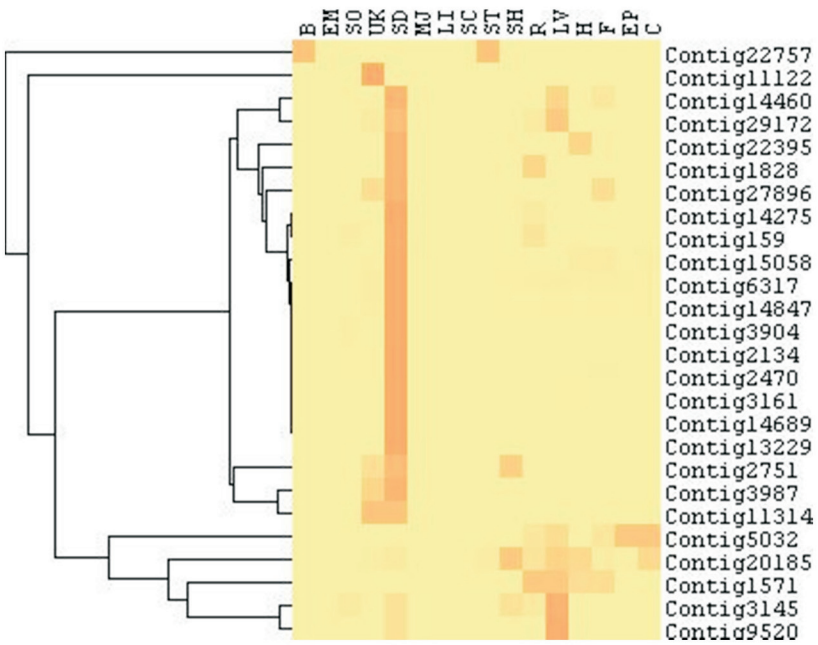

Figure S2 - *PR-2* expression profile in 16 different libraries from GENOSOJA.

Table S1 - Accession number of reference *PR*-genes used as seed sequences available at GenBank (www.ncbi.nlm.nih.gov/genbank/).

Gene family	Accession number
PR1	NP_179068
PR2	NP_191283
PR3	P19171
PR4	NP_187123
PR5	NP_177641.
PR6	PO4284.2
PR7	NP_566473
PR8	BAC55717
PR9	NP_195468
PR10	ACG68733
PR11	NP_193716
PR12	NP_178231
PR13	NP_176784
PR14	NP_190737
PR15	AAB561565.1
PR16	NP_001061164
PR17	NP_565369

Table S2 - Number of SuperSAGE tags per comparison (stressed library *versus* negative control for each gene family) that aligned with soybean candidates. Comparisons regarded: (1) BR-16 (drought susceptible stressed plants *vs.* negative control); (2) Embrapa-48 (drought tolerant plants after stress *vs.* negative control), and (3) PI561356 (rust fungus resistant plants after stress *vs.* negative control).

Soybean Candidate	Library			Gene
	BR16 drought	Embrapa 48 drought	PI561356 Rust	
lcl|Contig5043	1	1	1	*PR1*
lcl|Contig5340	-	-	2	*PR1*
lcl|Contig5622	-	1	3	*PR1*
lcl|Contig14460	2	1	2	*PR2*
lcl|Contig14847	1	2	1	*PR2*
lcl|Contig159	1	1	-	*PR2*
lcl|Contig20185	2	3	8	*PR2*
lcl|Contig2134	1	2	2	*PR2*
lcl|Contig22072	2	-	2	*PR2*
lcl|Contig2470	-	1	-	*PR2*
lcl|Contig29172	1		1	*PR2*
lcl|Contig3145	1	-	-	*PR2*
lcl|Contig3161	1	1	-	*PR2*
lcl|Contig3904	2	1	2	*PR2*
lcl|Contig5032	2	2	1	*PR2*
lcl|Contig6317	1	2	1	*PR2*
lcl|Contig9520	-	-	2	*PR2*
lcl|Contig10013	1	-	-	*PR3*
lcl|Contig10145	1	1	1	*PR3*
lcl|Contig18611	2	2	2	*PR3*
lcl|Contig5557	2	2	2	*PR3*
lcl|SJ10-E1-R02-030-H03-UC.F	1			*PR3*
lcl|Contig20547	1		1	*PR4*
lcl|Contig12689	1	2	-	*PR5*
lcl|Contig12911	2	1	2	*PR5*
lcl|Contig16449	1	2	1	*PR5*
lcl|Contig22645	1	1	2	*PR5*
lcl|Contig22677	1	1	2	*PR5*
lcl|Contig22938	1	1	1	*PR5*
lcl|Contig24536	-	-	1	*PR5*
lcl|Contig24536	1	-	1	*PR5*
lcl|Contig25189	1	-	-	*PR5*

lcl|Contig25013	-	-	1	*PR5*
lcl|Contig25607	1	1	2	*PR5*
lcl|Contig26929	1	1	1	*PR5*
lcl|Contig28061	1	2	1	*PR5*
lcl|Contig28178	1	1	-	*PR5*
lcl|Contig29866	1	2	2	*PR5*
lcl|Contig3417	1	1	-	*PR5*
lcl|Contig7692	2	2	1	*PR5*
lcl|SJ01-E1-UK1-038-E03-UC.F	1		1	*PR5*
lcl|Contig12580	1	-	1	*PR6*
lcl|Contig10512	2	2	3	*PR7*
lcl|Contig11169	1	-	-	*PR7*
lcl|Contig1213	1	1	1	*PR7*
lcl|Contig1587	1	1	1	*PR7*
lcl|Contig17318	2	1	-	*PR7*
lcl|Contig18694	1	-	1	*PR7*
lcl|Contig22043	2	1	1	*PR7*
lcl|Contig22743	-	1	-	*PR7*
lcl|Contig23199	2	2	1	*PR7*
lcl|Contig24129	-	1	-	*PR7*
lcl|Contig28939	1	1	1	*PR7*
lcl|Contig5644	1	1	-	*PR7*
lcl|Contig5834	1	1	1	*PR7*
lcl|Contig66	1	1	1	*PR7*
lcl|Contig8136	1	1	-	*PR7*
lcl|Contig14006	1	-	-	*PR8*
lcl|SJ01-E1-R06-050-A09-UC.F	1	1	tag14886	*PR8*
lcl|SJ01-E1-UK1-115-A10-UC.F	2	1	-	*PR8*
lcl|Contig11038	8	6	7	*PR9*
lcl|Contig12733	5	8	-	*PR9*
lcl|Contig12950	1		-	*PR9*
lcl|Contig13633	1	1	-	*PR9*
lcl|Contig13925	2	2	-	*PR9*
lcl|Contig14649	7	8	2	*PR9*
lcl|Contig15952	3	4	1	*PR9*
lcl|Contig16295	1	2	3	*PR9*
lcl|Contig1650	-	-	1	*PR9*
lcl|Contig16508	1	1	1	*PR9*
lcl|Contig17102	3	3	3	*PR9*
lcl|Contig1789	1	1	-	*PR9*
lcl|Contig1796	1	1	2	*PR9*
lcl|Contig18125	3	2	-	*PR9*
lcl|Contig18755	2	4	2	*PR9*
lcl|Contig18828	6	6	-	*PR9*

lcl|Contig19038	1	-	-	*PR9*
lcl|Contig22575	-	1	2	*PR9*
lcl|Contig2294	1	-	-	*PR9*
lcl|Contig22941	2	4	3	*PR9*
lcl|Contig24592	1	1	-	*PR9*
lcl|Contig24605	-	2	-	*PR9*
lcl|Contig26515	1	1	1	*PR9*
lcl|Contig26734	-	1	-	*PR9*
lcl|Contig27012	2	2	-	*PR9*
lcl|Contig27047	2	2	2	*PR9*
lcl|Contig28696	1	2	1	*PR9*
lcl|Contig28886	10	6	2	*PR9*
lcl|Contig29	9	7	4	*PR9*
lcl|Contig29008	1	1	1	*PR9*
lcl|Contig29257	1	1	-	*PR9*
lcl|Contig29443	1	1	-	*PR9*
lcl|Contig29478	7	3	2	*PR9*
lcl|Contig29812	1	1	1	*PR9*
lcl|Contig3102	1	2	2	*PR9*
lcl|Contig3522	-	-	1	*PR9*
lcl|Contig4928	10	9	-	*PR9*
lcl|Contig5160	4	2	2	*PR9*
lcl|Contig5380	1	1	1	*PR9*
lcl|Contig5387	2	1	-	*PR9*
lcl|Contig6568	3	5	3	*PR9*
lcl|Contig7695	1	1	-	*PR9*
lcl|SJ02-E1-S09-032-D09-UC.F	1	-	-	*PR9*
lcl|SJ09-E1-R06-053-A05-UC.F	1	1	-	*PR9*
lcl|Contig5806	1	1	1	*PR11*
lcl|Contig13869	2	2	1	*PR12*
lcl|Contig16662	1	2	-	*PR12*
lcl|Contig12623	3	2	11	*PR14*
lcl|Contig21156	-	-	3	*PR14*
lcl|SJ01-E1-L02-006-H12-UC.F	-	-	2	*PR14*
lcl|SJ01-E1-R06-168-C02-UC.F	1	1	-	*PR14*
lcl|SJ05-E1-S06-015-A03-UC.F	-	-	9	*PR14*
lcl|Contig10296	4	1	-	*PR15*
lcl|Contig10535	-	1	7	*PR15*
lcl|Contig10674	3	4	-	*PR15*
lcl|Contig13716	3	2	-	*PR15*
lcl|Contig13935	-	-	7	*PR15*
lcl|Contig14301	3	-	-	*PR15*
lcl|Contig20848	5	4	3	*PR15*
lcl|Contig219	-	1	1	*PR15*

lcl|Contig5627	1	-	5	*PR15*
lcl|SJ01-E1-UK1-089-G01-UC.F	1	1	1	*PR15*
lcl|SJ09-E1-R06-077-C09-UC.F	2	2	1	*PR15*
lcl|SJ01-E1-H05-025-G09-UC.F	-	-	1	*PR16*
lcl|Contig5666	1	1	1	*BS2 - PRf -RX1*
lcl|Contig14823	2	2	1	*Cf2*
lcl|Contig18082	1	-	1	*Cf2*
lcl|Contig26165	-	-	1	*Cf2*
lcl|SJ06-E1-SO1-012-D11-UC.F	-	-	1	*Cf2 - Cf9*
lcl|Contig3870	1	-	1	*Cf4 - Cf5*
lcl|SJ01-E1-L03-001-A03-UC.F	-	1		*Cf4 - Cf5*
lcl|SJ01-E1-S08-009-G07-UC.F		-	1	*Cf4 - Cf5*
lcl|SJ04-E1-R03-003-C09-UC.F	1	-	-	*Cf4 - Cf5*
lcl|Contig14012	1	2	-	*Cf4 - Cf5 - Cf9*
lcl|Contig2360	1	1	1	*Cf5*
lcl|SJ15-E1-S02-011-F11-UC.F	1	-	-	*Cf5 - Cf9*
lcl|Contig14024	1	1	-	*Cf9*
lcl|Contig14386	-	-	2	*Cf9*
lcl|Contig14808	-	-	1	*Cf9*
lcl|Contig3275	1	1	1	*Cf9*
lcl|Contig5105	2	2	1	*Cf9*
lcl|SJ01-E1-L08-094-B10-UC.F	1	1	-	*Cf9*
lcl|SJ01-E1-L08-103-F11-UC.F	1	1	-	*Cf9*
lcl|SJ10-E1-R02-040-F05-UC.F	1	1	1	*EFR - Cf2 - PTi1 -PBS1*
lcl|Contig9316	1	2	1	*EFR - Cf9 - Pto - Pti1 -PBS1*
lcl|Contig9539	2	1	1	*EFR - Cf9 - Pto - Pti1 -PBS1*
lc|Contig10494	3	1	2	*EFR - Pto - Pti1 -PBS1*
lcl|Contig22420	2	2	2	*EFR- Cf2 -Pto*
lcl|Contig12551	1	1	1	*FLS2 - EFR - Cf9*
lcl|Contig12573	1	1	2	*FLS2 - EFR - Cf9*
lcl|Contig12877	1	-	-	*FLS2 - EFR - Pti5*
lcl|Contig12246	1	1	1	*FLS2 - EFR - Xa21*
lcl|Contig1250	6	4	4	*FLS2 - EFR - Xa21*
lcl|Contig14252	1	2	1	*FLS2 - EFR - Xa21*
lcl|Contig22707	1	1	-	*FLS2 - EFR - Xa21*
lcl|Contig23308	1	1	1	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig24411	3	3	5	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig2445	1	-	1	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig24888	2	-	1	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig25227	2	2	1	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig26502	2	1	1	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig24527	1	1	1	*FLS2 - EFR - Xa21 - Cf9 - Pto*
lcl|Contig18743	1	-	1	*FLS2 - EFR - Xa21 - PBS1*
lcl|Contig2058	2	2	2	*FLS2 - EFR - Xa21 - Pti1 -PBS1*

lcl|Contig14179	-	1	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig14613	1	-	1	*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig15813	1	1	1	*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig15895	1	2	1	*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig16240	1	2	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig24680	1	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig24779	2	2	2	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig24805	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig24817	2	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26702	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26755	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26704	-	4	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26817	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26924	3	3	3	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig28360	1	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig28531	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig28840	2	1	5	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29006	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29266	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29534	2	2	2	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29597	1	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29719	1	1	2	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29630	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29807	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig3225	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig3261	-	-	2	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig4381	5	4	5	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig4413	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig439	-	-	2	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig5129	1	2	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig5707	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig6553	2	2	2	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig6867	2	2	2	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig7372	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig7373	2	1	3	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig8353	1	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig8377	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig9150	1	1	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig9912	2	2	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|SJ06-E1-SO1-055-C09-UC.F	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|SJ16-E1-L08-035-E06-UC.F	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig10023	4	4	3	*FSL2 - EFR - Xa21*
lcl|Contig10477	-	-	3	*FSL2 - EFR - Xa21*
lcl|Contig10595	3	1	3	*FSL2 - EFR - Xa21*

lcl|Contig10792	1	1	1	*FSL2 - EFR - Xa21-Cf2*
lcl|Contig22545	9	8	5	*I2*
lcl|SJ01-E1-H05-034-F11-UC.F	1	-	2	*I2 - RP1*
lcl|Contig4878	1	1	1	*N*
lcl|Contig6476	-	-	1	*N*
lcl|SJ01-E1-R02-001-B06-UC.F	-	-	1	*N*
lcl|SJ09-E1-R06-022-G04-UC.F	1	-	1	*N*
lcl|SJ18-P1-S12-320-S28-UC.F	-	1		*N*
lcl|Contig13260	1	1	1	*N - HERO*
lcl|Contig2014	1	2	2	*N - Hrt*
lcl|Contig14168	1	2	1	*N - Hrt - RPS4*
lcl|Contig14321	-	-	1	*N - Hrt - RPS4*
lcl|Contig14399	1	1	1	*N - Hrt - RPS4*
lcl|Contig14457	2	2	2	*N - Hrt - RPS4*
lcl|Contig15262	1	-	-	*N - Hrt - RPS4*
lcl|Contig14328	1	1	1	*N - Hrt - RPS4 - RRS1*
lcl|Contig13906	1	-	2	*N - RPP8*
lcl|Contig13906	1	-	2	*N - RPP8*
lcl|Contig16483	-	1	1	*N - RPS4*
lcl|Contig12054	1	1	-	*P*
lcl|Contig12187	9	13	5	*P*
lcl|Contig12243	1	2	-	*P*
lcl|Contig20164	1	-	-	*P*
lcl|Contig20542	1	3	1	*P*
lcl|Contig21287	1	3	-	*P*
lcl|Contig21292	2	1	-	*P*
lcl|Contig24379	1	1	-	*P*
lcl|Contig9298	1	2	1	*P*
lcl|Contig9530	-	1	-	*P*
lcl|Contig9674	1	1	-	*P*
lcl|SJ05-E1-H04-017-E08-UC.F	2	4	2	*P*
lcl|Contig13034	3	1	1	*PBS1*
lcl|Contig16308	2	1	-	*PBS1*
lcl|Contig1973	1	1	-	*PBS1*
lcl|Contig24527	-	-	1	*PBS1*
lcl|Contig26006	3	3	3	*PBS1*
lcl|Contig26953	1	1	1	*PBS1*
lcl|SJ01-E1-L06-026-D07-UC.F	1	-	2	*PBS1*
lcl|Contig12233	1	1	-	*PBS1 - Pti1*
lcl|Contig11191	3	2	2	*PBS1 - Pti5*
lcl|Contig19331	1	-	-	*Pib - Pti*
lcl|Contig8566	2	2	1	*Pti*
lcl|Contig18806	4	2	3	*Pti - Pto*
lcl|Contig18043	2	2	3	*Pti1 - PBS1*

lcl|Contig5248	1	-	1	*Pti1 - PBS1*
lcl|Contig5325	1	1	1	*Pti1 - PBS1*
lcl|Contig5428	1	1	1	*Pti1 - PBS1*
lcl|Contig5446	1	-	-	*Pti1 - PBS1*
lcl|Contig5479	1	1	1	*Pti1 - PBS1*
lcl|Contig9659	1	1	-	*Pti1 - PBS1*
lcl|SJ01-E1-S04-009-G09-UC.F	1	1	-	*Pti1 - PBS1*
lcl|Contig10922	1	1	1	*Pti1 - Pti4 - Pti5*
lcl|Contig22944	1	-	-	*Pti1 - Pto*
lcl|Contig23024	4	4	2	*Pti1 - Pto*
lcl|Contig23186	2	2	-	*Pti1 - Pto*
lcl|Contig24566	3	1	1	*Pti1 - Pto*
lcl|Contig26704	3	4	1	*Pti1 - Pto*
lcl|Contig14340	1	1	2	*Pti1 - Pto - PBS1*
lcl|Contig10666	1	1	1	*Pti4 - Pti5 - Pti6*
lcl|Contig10732	4	3	4	*Pti4 - Pti5 - Pti6*
lcl|Contig11904	1	-	-	*Pti4 - Pti5 - Pti6*
lcl|Contig12169	3	2	-	*Pti4 - Pti5 - Pti6*
lcl|Contig12202	3	1	1	*Pti4 - Pti5 - Pti6*
lcl|Contig15957	1	2	1	*Pti4 - Pti5 - Pti6*
lcl|Contig16018	1	1	1	*Pti4 - Pti5 - Pti6*
lcl|Contig16116	1	1	1	*Pti4 - Pti5 - Pti6*
lcl|Contig16201	1	-	1	*Pti4 - Pti5 - Pti6*
lcl|Contig16657	5	4	2	*Pti4 - Pti5 - Pti6*
lcl|Contig18308	4	2	1	*Pti4 - Pti5 - Pti6*
lcl|Contig20693	2	2	1	*Pti4 - Pti5 - Pti6*
lcl|Contig20781	3	2	2	*Pti4 - Pti5 - Pti6*
lcl|Contig20941	1	-	-	*Pti4 - Pti5 - Pti6*
lcl|Contig21955	1	1	1	*Pti4 - Pti5 - Pti6*
lcl|Contig24361	2	2	2	*Pti4 - Pti5 - Pti6*
lcl|Contig24917	4	3	6	*Pti4 - Pti5 - Pti6*
lcl|Contig24996	1	1	2	*Pti4 - Pti5 - Pti6*
lcl|Contig27279	1	1	1	*Pti4 - Pti5 - Pti6*
lcl|Contig27359	1	-	1	*Pti4 - Pti5 - Pti6*
lcl|Contig2826	2	2	2	*Pti4 - Pti5 - Pti6*
lcl|Contig2822	-	-	1	*Pti4 - Pti5 - Pti6*
lcl|Contig28585	3	3	4	*Pti4 - Pti5 - Pti6*
lcl|Contig28754	1	1	-	*Pti4 - Pti5 - Pti6*
lcl|Contig29354	2	3	3	*Pti4 - Pti5 - Pti6*
lcl|Contig29443	-	-	1	*Pti4 - Pti5 - Pti6*
lcl|Contig3013	1	-	-	*Pti4 - Pti5 - Pti6*
lcl|Contig3053	2	2	2	*Pti4 - Pti5 - Pti6*
lcl|Contig3063	1	-	-	*Pti4 - Pti5 - Pti6*
lcl|Contig7033	1	-	2	*Pti4 - Pti5 - Pti6*

lcl|Contig7365	3	1	3	*Pti4 - Pti5 - Pti6*
lcl|SJ01-E1-SH2-103-B06-UC.F	3	3	1	*Pti4 - Pti5 - Pti6*
lcl|Contig16264	1	1	-	*Pti4 - Pti5 - Pti6 - PBS1*
lcl|Contig1472	2	1	1	*Pti5 - PBS1*
lcl|Contig15071	2	2	4	*Pti5 - PBS1*
lcl|Contig15350	-	1	-	*Pti5 - PBS1*
lcl|Contig1639	3	2	1	*Pti5 - PBS1*
lcl|Contig16504	1	1	3	*Pti5 - PBS1*
lcl|Contig16651	3	3	3	*Pti5 - PBS1*
lcl|Contig13328	3	4	3	*Pti5 - Pti6*
lcl|Contig1712	1	-	-	*Pti5 - Pti6*
lcl|Contig17311	-	2	1	*Pti5 - Pti6*
lcl|Contig17807	2	1	1	*Pti5 - Pti6*
lcl|Contig1937	1	1	1	*Pti5 - Pti6*
lcl|Contig23305	-	1	-	*Pti5 - Pti6*
lcl|Contig16780	2	1	2	*Pti5 - Pti6 -Pti1*
lcl|Contig16894	2	1	1	*Pti5 - Pti6 -Pti1*
lcl|Contig16984	1	1	1	*Pti5 - Pti6 -Pti1*
lcl|Contig1703	2	1	1	*Pti5 - Pti6 -Pti1*
lcl|Contig12383	1	-	1	*Pti5 - Pto*
lcl|Contig12416	1	1	-	*Pti5 - Pto*
lcl|Contig12431	3	1	1	*Pti5 - Pto - PBS1*
lcl|Contig13901	1	-	-	*Pti5 - Pto - PBS1*
lcl|Contig13987	1	-	-	*Pti5 - Pto - PBS1*
lcl|Contig13974	-	1	-	*Pti5 - Pto - PBS1*
lcl|Contig12319	1	1	1	*Pti6*
lcl|Contig16476	-	-	1	*Pti6*
lcl|Contig18617	1	1	1	*Pti6*
lcl|Contig26930	2	1	1	*Pti6*
lcl|Contig329	2	1	4	*Pti6*
lcl|Contig3494	1	1	1	*Pti6*
lcl|Contig3532	1	-	1	*Pti6*
lcl|Contig3736	2	2	-	*Pti6*
lcl|Contig3750	1	-	1	*Pti6*
lcl|Contig4658	3	3	2	*Pti6*
lcl|Contig7932	1	1	1	*Pti6*
lcl|Contig18526	3	1	1	*Pto*
lcl|Contig754	5	3	3	*Pto*
lcl|SJ01-E1-F02-014-G08-UC.F	1	1	-	*Pto*
lcl|SJ01-E1-L02-003-B01-UC.F	1	-	1	*Pto*
lcl|SJ01-E1-L08-096-F09-UC.F	1	-	-	*Pto*
lcl|SJ01-E1-L08-167-A07-UC.F	1	1	-	*Pto*
lcl|Contig14085	1	1	2	*Pto - PBS1*
lcl|Contig1867	1	1	1	*Pto - PBS1*

lcl|SJ10-E1-R05-031-A03-UC.F	1	-	-	*Pto - Pti1 -PBS1*
lcl|Contig21418	-	1	1	*Pto - Pti6*
lcl|Contig24612	1	-	1	*RAR1*
lcl|Contig27196	2	1	2	*RAR1*
lcl|Contig1149	3	1	3	*RIN4*
lcl|Contig1149	-	1	2	*RIN4*
lcl|Contig13859	1	-	-	*RIN4*
lcl|Contig20845	2	2	4	*RIN4*
lcl|Contig10273	1	-	1	*RPP13 - PRF - RPM1 - BS2 - RX1 -GPA2*
lcl|Contig1759	2	2	3	*RPS4 - Hrt*
lcl|Contig5517	3	-	1	*RPS4 - Xa1 -I2 -RP1*
lcl|Contig13135	2	2	3	*RRS1*
lcl|Contig1553	1	1	1	*RRS1*
lcl|Contig16492	5	3	3	*RRS1*
lcl|Contig17059	1	2	-	*RRS1*
lcl|Contig20831	-	-	1	*RRS1*
lcl|Contig29142	1	1	1	*RRS1*
lcl|Contig3057	1	-	-	*RRS1*
lcl|Contig3205	1	1	1	*RRS1*
lcl|Contig3637	1	2	2	*RRS1*
lcl|Contig5209	1	2	1	*RRS1*
lcl|Contig5710	4	5	4	*RRS1*
lcl|Contig6095	4	6	2	*RRS1*
lcl|Contig7012	3	4	1	*RRS1*
lcl|Contig7418	-	-	1	*RRS1*
lcl|Contig7686	1	1	1	*RRS1*
lcl|Contig7998	1	1	3	*RRS1*
lcl|Contig9906	-	1	-	*RRS1*
lcl|SJ01-E1-S08-009-G01-UC.F	1	-	1	*RRS1*
lcl|SJ01-E1-S08-033-F04-UC.F	1	2	2	*RRS1*
lcl|SJ07-E1-S10-278-B02-UC.F	2	2	2	*RRS1*
lcl|SJ08-E1-F03-032-F04-UC.F	-	1	-	*RRS1*
lcl|SJ09-E1-R06-028-A06-UC.F	1	1	-	*RRS1*
lcl|SJ10-E1-R05-012-B04-UC.F	1	-	-	*RRS1 - N*
lcl|Contig18518	1	1	-	*RRS1 - WRKY25*
lcl|Contig10629	3	4	2	*RRS1 - WRKY25 -WRKY33*
lcl|Contig12608	1	-	1	*RRS1 - WRKY25 -WRKY33*
lcl|Contig16939	1	-	-	*RX1 - RPP8*
lcl|Contig1110	7	3	5	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
lcl|Contig3286	1	-	-	*WRKY25 - WRKY29 - WRKY33*
lcl|Contig3348	2	2	2	*WRKY25 - WRKY29 - WRKY33*
lcl|Contig23005	1	1	1	*WRKY25 - WRKY29 - WRKY33 -RRS1*
lcl|Contig23015	2	2	1	*WRKY25 - WRKY29 - WRKY33 -RRS1*
lcl|Contig26942	1	-	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*

lcl|Contig5035	1	2	-	*WRKY25 - WRKY29 - WRKY33 - RRS1*
lcl|Contig1193	1	1	1	*WRKY25 - WRKY29 - WRKY33 - RRS1*
lcl|Contig12175	4	1	1	*WRKY25 - WRKY29 - WRKY33 - RRS1*
lcl|Contig26670	4	1	1	*WRKY25 - WRKY33*
lcl|Contig16225	1	-	3	*WRKY25 - WRKY33 - RRS1*
lcl|Contig18831	4	7	4	*WRKY25 - WRKY33 - RRS1*
lcl|Contig21048	3	2	3	*WRKY25 - WRKY33 -RRS1*
lcl|Contig2139	5	3	4	*WRKY25 - WRKY33 -RRS1*
lcl|Contig23415	1	1	1	*WRKY25 - WRKY33 -RRS1*
lcl|SJ01-E1-L08-104-F11-UC.F	-	1	-	*WRKY33*
lcl|Contig11275	1	1	-	*WRKY33 - WRKY25 - WRKY29*
lcl|Contig1863	2	1	1	*Xa1*
lcl|Contig8174	1	-	1	*Xa1*
lcl|Contig21003	1	1	1	*Xa1 - I2 - RP1*

Table S3 - SuperSAGE tags that matched to the procured genes in each library comparison, considering: (1) BR-16 (drought susceptible stressed plants *vs.* negative control); (2) Embrapa-48 (drought tolerant plants after stress *vs.* negative control), and (3) PI561356 (rust fungus resistant plants after stress *vs.* negative control).

Soybean Candidate	Library			Gene
	BR16 drought	Embrapa 48 drought	PI561356 Rust	
lcl|Contig5043	tag68862	tag59808	tag100268	*PR1*
lcl|Contig5340			tag102706	*PR1*
			tag16280	*PR1*
lcl|Contig5622		tag63365	tag50951	*PR1*
			tag34342	*PR1*
			tag102706	*PR1*
lcl|Contig14460	tag36506	tag10066	tag78070	*PR2*
	tag11357		tag60582	*PR2*
lcl|Contig14847	tag46409	tag39145	tag84826	*PR2*
		tag3630		*PR2*
lcl|Contig159	tag32168	tag22491		*PR2*
lcl|Contig20185	tag68310	tag59329	tag99853	*PR2*
	tag44889	tag38968	tag65175	*PR2*
		tag25980	tag31437	*PR2*
			tag20988	*PR2*
			tag90186	*PR2*
			tag57103	*PR2*
			tag55954	*PR2*
			tag78351	*PR2*
lcl|Contig2134	tag9100	tag8419	tag44671	*PR2*
		tag8014	tag15360	*PR2*
lcl|Contig22072	tag47808		tag85817	*PR2*
	tag45846		tag84463	*PR2*
lcl|Contig2470		tag35479		*PR2*
lcl|Contig29172	tag25841		tag18033	*PR2*
lcl|Contig3145	tag82314			*PR2*
lcl|Contig3161	tag56871	tag49381		*PR2*
lcl|Contig3904	tag27708	tag24029	tag71925	*PR2*
	tag8887		tag44671	*PR2*
lcl|Contig5032	tag59047	tag51236	tag8767	*PR2*
	tag12216	tag10804		*PR2*
lcl|Contig6317	tag37813	tag66054	tag78981	*PR2*
		tag32848		*PR2*
lcl|Contig9520			tag65175	*PR2*

			tag19166	*PR2*
lcl|Contig10013	tag6497			*PR3*
lcl|Contig10145	tag84062	tag16468	tag65653	*PR3*
lcl|Contig18611	tag46904	tag40711	tag85166	*PR3*
	tag24957	tag21694	tag69947	*PR3*
lcl|Contig5557	tag46904	tag40711	tag85166	*PR3*
	tag24957	tag21694	tag69947	*PR3*
lcl|SJ10-E1-R02-030-H03-UC.F	tag40898			*PR3*
lcl|Contig20547	tag3237		tag2342	*PR4*
lcl|Contig12689	tag11624	tag10308		*PR5*
		tag59923		*PR5*
lcl|Contig12911	tag68146	tag59192	tag99740	*PR5*
	tag36545		tag83791	*PR5*
lcl|Contig16449	tag39153	tag42604	tag34308	*PR5*
		tag33990		*PR5*
lcl|Contig22645	tag72021	tag62569	tag102419	*PR5*
			tag86894	*PR5*
lcl|Contig22677	tag72021	tag62569	tag102419	*PR5*
			tag86894	*PR5*
lcl|Contig22938	tag59796	tag51894	tag93861	*PR5*
lcl|Contig24536			tag95623	*PR5*
lcl|Contig24536	tag88038		tag95623	*PR5*
lcl|Contig25189	tag18502			*PR5*
lcl|Contig25013			tag11057	*PR5*
lcl|Contig25607	tag34943	tag30354	tag52864	*PR5*
			tag24460	*PR5*
lcl|Contig26929	tag43928	tag38158	tag83161	*PR5*
lcl|Contig28061	tag54332	tag59695	tag100179	*PR5*
		tag43008		*PR5*
lcl|Contig28178	tag6303	tag5543		*PR5*
lcl|Contig29866	tag40848	tag43561	tag35072	*PR5*
		tag35455	tag28557	*PR5*
lcl|Contig3417	tag13755	tag37529		*PR5*
lcl|Contig7692	tag54405	tag47268	tag90279	*PR5*
	tag39153	tag33990		*PR5*
lcl|SJ01-E1-UK1-038-E03-UC.F	tag36545		tag83791	*PR5*
lcl|Contig12580	tag33709		tag23570	*PR6*
lcl|Contig10512	tag73367	tag63779	tag103318	*PR7*
	tag42520	tag36937	tag82209	*PR7*
	-	-	tag38565	*PR7*
lcl|Contig11169	tag15428			*PR7*
lcl|Contig1213	tag73725	tag64082	tag51507	*PR7*
lcl|Contig1587	tag14160	tag12396	tag10006	*PR7*
lcl|Contig15895	tag70564	tag61249	tag101411	*PR7*

		tag71329		*PR7*
lcl|Contig17318	tag72725	tag507		*PR7*
	tag587			*PR7*
lcl|Contig18694	tag43368		tag82788	*PR7*
	tag27645			*PR7*
lcl|Contig22743		tag69586		*PR7*
lcl|Contig23199	tag48537	tag42144	tag33928	*PR7*
	tag81403	tag28831		*PR7*
lcl|Contig24129		tag57212		*PR7*
lcl|Contig28939	tag56378	tag48948	tag91607	*PR7*
lcl|Contig5644	tag59417	tag51549		*PR7*
lcl|Contig5834	tag63527	tag55118	tag44413	*PR7*
lcl|Contig66	tag55325	tag48033	tag38681	*PR7*
lcl|Contig8136	tag30937	tag26815		*PR7*
lcl|Contig14006	tag76047			*PR8*
lcl|SJ01-E1-R06-050-A09-UC.F	tag21254	tag18553	tag14886	*PR8*
lcl|SJ01-E1-UK1-115-A10-UC.F	tag81219	tag17523		*PR8*
	tag20061			*PR8*
lcl|Contig11038	tag75271	tag65430	tag99856	*PR9*
	tag68312	tag59331	tag91726	*PR9*
	tag62767	tag54452	tag67700	*PR9*
	tag62505	tag49083	tag61952	*PR9*
	tag56540	tag18917	tag52634	*PR9*
	tag21687	tag11764	tag43850	*PR9*
	tag13366		tag31752	*PR9*
	tag65820			*PR9*
lcl|Contig12733	tag47964	tag49457		*PR9*
	tag30181	tag41643		*PR9*
	tag13774	tag12076		*PR9*
	tag23759	tag53054		*PR9*
	tag27669	tag20661		*PR9*
		tag13703		*PR9*
		tag43751		*PR9*
		tag23994		*PR9*
lcl|Contig12950	tag38493			*PR9*
lcl|Contig13633	tag10788	tag9541		*PR9*
lcl|Contig13925	tag86318	tag60314		*PR9*
	tag69480	tag37338		*PR9*
lcl|Contig14649	tag63503	tag55099	tag44409	*PR9*
	tag15623	tag29415	tag10968	*PR9*
	tag73735	tag13623		*PR9*
	tag53941	tag64096		*PR9*
	tag14361	tag47602		*PR9*
	tag82188	tag12559		*PR9*

	tag76663	tag64138		*PR9*
		tag22323		*PR9*
lcl|Contig15952	tag73309	tag63728	tag30966	*PR9*
	tag64006	tag55548		*PR9*
	tag44168	tag38356		*PR9*
		tag73046		*PR9*
lcl|Contig16295	tag5607	tag4956	tag56629	*PR9*
		tag3920	tag55819	*PR9*
			tag66855	*PR9*
lcl|Contig1650	tag18529		tag65409	*PR9*
lcl|Contig16508	tag10923	tag9652	tag7776	*PR9*
lcl|Contig17102	tag57755	tag50127	tag85363	*PR9*
	tag47177	tag40947	tag31557	*PR9*
	tag45058	tag39113	tag24811	*PR9*
				PR9
lcl|Contig1789	tag48105	tag41775		*PR9*
lcl|Contig1796	tag29031	tag25183	tag73987	*PR9*
			tag20336	*PR9*
lcl|Contig18125	tag50977	tag44230		*PR9*
	tag45201	tag39253		*PR9*
	tag55536			*PR9*
lcl|Contig18755	tag69755	tag60552	tag85684	*PR9*
	tag47623	tag45523	tag48740	*PR9*
		tag41345		*PR9*
		tag29511		*PR9*
lcl|Contig18828	tag63270	tag54888		*PR9*
	tag63004	tag43686		*PR9*
	tag50325	tag37957		*PR9*
	tag32758	tag28407		*PR9*
	tag16826	tag14659		*PR9*
	tag82780	tag14161		*PR9*
lcl|Contig19038	tag10694			*PR9*
lcl|Contig22575		tag39018	tag73987	*PR9*
			tag27449	*PR9*
lcl|Contig2294	tag2046			*PR9*
lcl|Contig22941	tag33371	tag39018	tag75887	*PR9*
	tag32292	tag30167	tag73987	*PR9*
		tag28922	tag27449	*PR9*
		tag38141		*PR9*
lcl|Contig24592	tag76297	tag7655		*PR9*
lcl|Contig24605		tag17893		*PR9*
		tag15804		*PR9*
lcl|Contig26515	tag9567	tag8445	tag6769	*PR9*
lcl|Contig26734		tag40779		*PR9*

lcl|Contig27012	tag12527	tag11095		*PR9*
	tag61432	tag53305		*PR9*
lcl|Contig27047	tag40525	tag35156	tag80847	*PR9*
	tag31706	tag27497	tag74770	*PR9*
lcl|Contig28696	tag71438	tag62021	tag101995	*PR9*
		tag4466		*PR9*
lcl|Contig28886	tag73748	tag56067	tag103561	*PR9*
	tag64639	tag39080	tag510	*PR9*
	tag45019	tag6500		*PR9*
	tag31965	tag5046		*PR9*
	tag22449	tag624		*PR9*
	tag7368	tag40921		*PR9*
	tag5706			*PR9*
	tag731			*PR9*
	tag47135			*PR9*
	tag7037			*PR9*
lcl|Contig29	tag64424	tag55889	tag87711	*PR9*
	tag58836	tag43498	tag57982	*PR9*
	tag50098	tag42753	tag45031	*PR9*
	tag49240	tag7336	tag34434	*PR9*
	tag40936	tag6718		*PR9*
	tag7626	tag4741		*PR9*
	tag5371	tag60812		*PR9*
	tag67744			*PR9*
	tag44672			*PR9*
lcl|Contig29008	tag4213	tag3677	tag2972	*PR9*
lcl|Contig29257	tag5706	tag5046		*PR9*
lcl|Contig29443	tag73309	tag63728		*PR9*
lcl|Contig29478	tag42274	tag35677	tag81203	*PR9*
	tag41088	tag2667	tag49486	*PR9*
	tag39530	tag61481		*PR9*
	tag57784			*PR9*
	tag3046			*PR9*
	tag70826			*PR9*
	tag7604			*PR9*
lcl|Contig29443			tag63728	*PR9*
lcl|Contig29812	tag61850	tag53695	tag95352	*PR9*
lcl|Contig3102	tag2220	tag32028	tag78338	*PR9*
		tag1944	tag54293	*PR9*
lcl|Contig3522			tag47852	*PR9*
lcl|Contig4928	tag51456	tag44648		*PR9*
	tag36620	tag25018		*PR9*
	tag28820	tag13747		*PR9*
	tag15759	tag9739		*PR9*

	tag11011	tag3093		*PR9*
	tag9868	tag34712		*PR9*
	tag3509	tag44776		*PR9*
	tag16792	tag43437		*PR9*
	tag51622			*PR9*
	tag50037			*PR9*
lcl|Contig5160	tag61942	tag53779	tag95413	*PR9*
	tag36745	tag31877	tag25699	*PR9*
	tag85253			*PR9*
	tag79573			*PR9*
lcl|Contig5380	tag39347	tag34163	tag80034	*PR9*
lcl|Contig5387	tag29446	tag69865		*PR9*
	tag55529			*PR9*
lcl|Contig6568	tag68947	tag59888	tag99224	*PR9*
	tag67418	tag59075	tag48209	*PR9*
	tag57755	tag58524	tag48340	*PR9*
		tag50127		*PR9*
lcl|Contig7695	tag67144	tag58288		*PR9*
lcl|SJ02-E1-S09-032-D09-UC.F	tag11170			*PR9*
lcl|SJ09-E1-R06-053-A05-UC.F	tag34506	tag29936		*PR9*
lcl|Contig5806	tag12111	tag10722	tag61105	*PR11*
lcl|Contig13869	tag38129	tag63863	tag79190	*PR12*
	tag28596	tag33107		*PR12*
lcl|Contig16662	tag8804	tag7739		*PR12*
		tag68143		*PR12*
lcl|Contig12623	tag21232	tag18533	tag78383	*PR14*
	tag10901	tag9633	tag67404	*PR14*
	tag75702		tag65457	*PR14*
			tag52712	*PR14*
			tag56437	*PR14*
			tag56160	*PR14*
			tag45012	*PR14*
			tag7757	*PR14*
			tag2916	*PR14*
			tag84817	*PR14*
			tag30824	*PR14*
lcl|Contig21156			tag73712	*PR14*
			tag54753	*PR14*
			tag48988	*PR14*
lcl|SJ01-E1-L02-006-H12-UC.F			tag65457	*PR14*
			tag45012	*PR14*
lcl|SJ01-E1-R06-168-C02-UC.F	tag15323	tag13369		*PR14*
lcl|SJ05-E1-S06-015-A03-UC.F			tag78383	*PR14*
			tag52712	*PR14*

			tag56437	*PR14*
			tag56160	*PR14*
			tag45012	*PR14*
			tag2916	*PR14*
			tag84817	*PR14*
			tag30824	*PR14*
			tag96592	*PR14*
lcl|Contig10296	tag23470	tag20416		*PR15*
	tag86141			*PR15*
	tag82068			*PR15*
	tag83099			*PR15*
lcl|Contig10535	-	tag8400	tag94139	*PR15*
			tag59275	*PR15*
			tag56268	*PR15*
			tag51440	*PR15*
			tag95242	*PR15*
			tag54288	*PR15*
			tag42789	*PR15*
lcl|Contig10674	tag33302	tag28872		*PR15*
	tag13503	tag11868		*PR15*
	tag48731	tag10170		*PR15*
		tag42308		*PR15*
lcl|Contig13716	tag71417	tag62001		*PR15*
	tag85112	tag31225		*PR15*
	tag83099			*PR15*
lcl|Contig13935			tag94139	*PR15*
			tag87080	*PR15*
			tag64000	*PR15*
			tag35573	*PR15*
			tag33849	*PR15*
			tag4835	*PR15*
			tag103916	*PR15*
lcl|Contig14301	tag407			*PR15*
	tag78299			*PR15*
	tag54462			*PR15*
lcl|Contig20848	tag62272	tag54059	tag43509	*PR15*
	tag40118	tag34786	tag28048	*PR15*
	tag35476	tag30789	tag24816	*PR15*
	tag31368	tag27180		*PR15*
	tag26209			*PR15*
lcl|Contig219		tag2035	tag34622	*PR15*
lcl|Contig22043	tag60445	tag52450	tag94347	*PR15*
lcl|Contig5627	tag20934		tag93250	*PR15*
			tag67193	*PR15*

			tag51563	*PR15*
			tag11974	*PR15*
			tag11581	*PR15*
lcl|SJ01-E1-UK1-089-G01-UC.F	tag62272	tag54059	tag43509	*PR15*
lcl|SJ09-E1-R06-077-C09-UC.F	tag62272	tag54059	tag43509	*PR15*
	tag31368	tag27180		*PR15*
lcl|SJ01-E1-H05-025-G09-UC.F			tag9971	*PR16*
lcl|Contig5666	tag56140	tag48752	tag91464	*BS2 - PRf -RX1*
lcl|Contig14823	tag23443	tag20395	tag16346	*Cf2*
	tag1825	tag1584		*Cf2*
				Cf2
lcl|Contig18082	tag4180		tag55597	*Cf2*
lcl|Contig26165			tag63505	*Cf2*
lcl|SJ06-E1-SO1-012-D11-UC.F			tag46933	*Cf2 - Cf9*
lcl|Contig3870	tag82562		tag54404	*Cf4 - Cf5*
lcl|SJ01-E1-L03-001-A03-UC.F		tag15217		*Cf4 - Cf5*
lcl|SJ01-E1-S08-009-G07-UC.F			tag74969	*Cf4 - Cf5*
lcl|SJ04-E1-R03-003-C09-UC.F	tag4316			*Cf4 - Cf5*
lcl|Contig14012	tag25569	tag22238		*Cf4 - Cf5 - Cf9*
		tag32332		*Cf4 - Cf5 - Cf9*
lcl|Contig2360	tag10486	tag9245	tag7436	*Cf5*
lcl|SJ15-E1-S02-011-F11-UC.F	tag13833			*Cf5 - Cf9*
lcl|Contig14024	tag41449	tag35989		*Cf9*
lcl|Contig14386			tag82368	*Cf9*
			tag77694	*Cf9*
lcl|Contig14808			tag46933	*Cf9*
lcl|Contig3261			tag70618	*Cf9*
lcl|Contig5105	tag84778	tag56533	tag97554	*Cf9*
	tag65134	tag23068		*Cf9*
lcl|SJ01-E1-L08-094-B10-UC.F	tag84028	tag16128		*Cf9*
lcl|SJ01-E1-L08-103-F11-UC.F	tag17517	tag15291		*Cf9*
lcl|SJ10-E1-R02-040-F05-UC.F	tag75388	tag65516	tag52718	*EFR - Cf2 - PTi1 -PBS1*
lcl|Contig9316	tag41573	tag13871	tag81545	*EFR - Cf9 - Pto - Pti1 -PBS1*
		tag36108		*EFR - Cf9 - Pto - Pti1 -PBS1*
lcl|Contig9539	tag71478	tag62057	tag49923	*EFR - Cf9 - Pto - Pti1 -PBS1*
	tag59074			*EFR - Cf9 - Pto - Pti1 -PBS1*
lcl|Contig10494	tag64021	tag55560	tag58771	*EFR - Pto - Pti1 -PBS1*
	tag46819		tag44767	*EFR - Pto - Pti1 -PBS1*
	tag8800			*EFR - Pto - Pti1 -PBS1*
lcl|Contig22420	tag41094	tag35684	tag28724	*EFR- Cf2 -Pto*
	tag33523	tag29051	tag23422	*EFR- Cf2 -Pto*
lcl|Contig12551	tag68829	tag59785	tag48136	*FLS2 - EFR - Cf9*
lcl|Contig12573	tag59877	tag51957	tag41802	*FLS2 - EFR - Cf9*
			tag13476	*FLS2 - EFR - Cf9*

lcl|Contig12877	tag9115			*FLS2 - EFR - Pti5*
lcl|Contig12246	tag385	tag327	tag299	*FLS2 - EFR - Xa21*
lcl|Contig1250	tag54429	tag47286	tag90297	*FLS2 - EFR - Xa21*
	tag45560	tag39554	tag84264	*FLS2 - EFR - Xa21*
	tag25398	tag22088	tag2167	*FLS2 - EFR - Xa21*
	tag2979	tag2600	tag3121	*FLS2 - EFR - Xa21*
	tag61962			*FLS2 - EFR - Xa21*
	tag75878			*FLS2 - EFR - Xa21*
lcl|Contig14252	tag28546	tag37837	tag72508	*FLS2 - EFR - Xa21*
		tag24786		*FLS2 - EFR - Xa21*
lcl|Contig22707	tag13981	tag12246		*FLS2 - EFR - Xa21*
lcl|Contig23308	tag64371	tag55838	tag45002	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig24411	tag52291	tag45347	tag88790	*FLS2 - EFR - Xa21 - Cf9*
	tag41392	tag35941	tag81414	*FLS2 - EFR - Xa21 - Cf9*
	tag19095	tag16689	tag65861	*FLS2 - EFR - Xa21 - Cf9*
			tag27957	*FLS2 - EFR - Xa21 - Cf9*
			tag34866	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig2445	tag82562		tag54404	*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig24460	tag81368	tag56626		*FLS2 - EFR - Xa21 - Cf9*
		tag51087		*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig24888	tag13833		tag53258	*FLS2 - EFR - Xa21 - Cf9*
	tag716			*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig25227	tag50867	tag44130	tag87863	*FLS2 - EFR - Xa21 - Cf9*
	tag4885	tag4286		*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig26502	tag50867	tag44130	tag87863	*FLS2 - EFR - Xa21 - Cf9*
	tag43120			*FLS2 - EFR - Xa21 - Cf9*
lcl|Contig24527	tag937	tag805	tag673	*FLS2 - EFR - Xa21 - Cf9 - Pto*
lcl|Contig18743	tag8154		tag5809	*FLS2 - EFR - Xa21 - PBS1*
lcl|Contig2058	tag88766	tag61118	tag101294	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
	tag37224	tag2120	tag77869	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
lcl|Contig14179		tag65160		*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig14613	tag80835		tag41621	*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig15813	tag20485	tag17895	tag84995	*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig16240	tag23653	tag72626		*FLS2 - EFR - Xa21 - Pto - PBS1*
		tag20580		*FLS2 - EFR - Xa21 - Pto - PBS1*
lcl|Contig24680	tag50530		tag11508	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig24779	tag73463	tag63860	tag103383	*FLS2 - EFR - Xa21 - Pto - Pti1*
	tag56636	tag49167	tag91780	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig24805	tag58111	tag50448	tag40543	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig24817	tag13460		tag9568	*FLS2 - EFR - Xa21 - Pto - Pti1*
	tag12945			*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26702		tag35449		*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26755	tag14701	tag12850	tag62802	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26704		tag72860		*FLS2 - EFR - Xa21 - Pto - Pti1*

		tag56626		*FLS2 - EFR - Xa21 - Pto - Pti1*
		tag54219		*FLS2 - EFR - Xa21 - Pto - Pti1*
		tag51087		*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26817	tag48584	tag42184	tag43417	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig26924	tag65387	tag56745	tag73514	*FLS2 - EFR - Xa21 - Pto - Pti1*
	tag20522	tag17926	tag66909	*FLS2 - EFR - Xa21 - Pto - Pti1*
	tag2305	tag2019	tag54359	*FLS2 - EFR - Xa21 - Pto - Pti1*
lcl|Contig28360	tag24605		tag17153	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig28531	tag10857	tag9592	tag60229	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig28840	tag25422	tag22117	tag82274	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag16513		tag64005	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
			tag17783	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
			tag93189	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
			tag10388	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29006			tag26698	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29266	tag53215	tag46170	tag18056	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29534	tag54724	tag47375	tag56574	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag7075	tag6240	tag5029	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29597	tag3336		tag2418	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29719	tag20344	tag17765	tag14239	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29630			tag94258	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig29807			tag29877	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig3225	tag50204	tag43583	tag35092	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig3275	tag27810	tag24118	tag19804	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
			tag28857	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig4381	tag66853	tag58012	tag97407	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag64930	tag56360	tag46750	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag23567	tag26781	tag2456	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag70967	tag2999	tag50787	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag3393			*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig4413	tag5588	tag4935	tag3996	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig439			tag103512	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
			tag84013	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig5129	tag61503	tag10258	tag42964	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
		tag53357		*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig5707	tag21525	tag18771	tag15037	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig6553	tag60066	tag52127	tag94056	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag16851	tag14685	tag64229	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig6867	tag47034	tag40838	tag32908	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag73199	tag63615	tag1873	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig7372	tag53689			*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig7373	tag59198	tag41867	tag93456	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag48211		tag84995	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
			tag33706	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*

lcl|Contig8353	tag18953	tag16568		*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig8377	tag27199	tag23595	tag71589	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig9150	tag70416	tag61119	tag101295	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig9912	tag63444	tag55047	tag96375	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
	tag41197	tag35774		*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|SJ06-E1-SO1-055-C09-UC.F	tag26621			*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|SJ16-E1-L08-035-E06-UC.F			tag37425	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
lcl|Contig10023	tag50646	tag43942	tag87686	*FSL2 - EFR - Xa21*
	tag32878	tag28517	tag75578	*FSL2 - EFR - Xa21*
	tag18088	tag15813	tag12666	*FSL2 - EFR - Xa21*
	tag5606	tag4953		*FSL2 - EFR - Xa21*
lcl|Contig10477	-	-	tag102522	*FSL2 - EFR - Xa21*
			tag79682	*FSL2 - EFR - Xa21*
			tag45396	*FSL2 - EFR - Xa21*
lcl|Contig10595	tag61123	tag53049	tag84003	*FSL2 - EFR - Xa21*
	tag45193	-	tag65861	*FSL2 - EFR - Xa21*
	tag19095	-	tag34866	*FSL2 - EFR - Xa21*
lcl|Contig10792	tag35320	tag30654	tag77218	*FSL2 - EFR - Xa21-Cf2*
lcl|Contig22545	tag67743	tag51933	tag93890	*I2*
	tag54197	tag47080	tag90162	*I2*
	tag34479	tag31204	tag68819	*I2*
	tag32262	tag27961	tag62560	*I2*
	tag23311	tag20278	tag13358	*I2*
	tag19077	tag16677		*I2*
	tag14346	tag12550		*I2*
	tag6250	tag11334		*I2*
	tag12798			*I2*
lcl|SJ01-E1-H05-034-F11-UC.F	tag51514		tag41456	*I2 - RP1*
			tag26025	*I2 - RP1*
lcl|Contig4878	tag23934	tag20817	tag16692	*N*
lcl|Contig6476			tag49961	*N*
lcl|SJ01-E1-R02-001-B06-UC.F			tag101443	*N*
lcl|SJ09-E1-R06-022-G04-UC.F	tag9297		tag6581	*N*
lcl|SJ18-P1-S12-320-S28-UC.F		tag67059		*N*
lcl|Contig13260	tag30235	tag26215	tag21179	*N - HERO*
lcl|Contig2014	tag71759	tag62327	tag50150	*N - Hrt*
		tag45832	tag36876	*N - Hrt*
lcl|Contig14168	tag58736	tag50972	tag40989	*N - Hrt - RPS4*
		tag28505		*N - Hrt - RPS4*
lcl|Contig14321			tag10039	*N - Hrt - RPS4*
lcl|Contig14399	tag58736	tag50972	tag40989	*N - Hrt - RPS4*
lcl|Contig14457	tag66150	tag57390	tag98302	*N - Hrt - RPS4*
	tag20254	tag17689	tag66702	*N - Hrt - RPS4*
lcl|Contig15262	tag72756			*N - Hrt - RPS4*

lcl|Contig14328	tag60967	tag52924	tag42587	*N - Hrt - RPS4 - RRS1*
lcl|Contig13906	tag30235	tag26215	tag47987	*N - RPP8*
			tag21179	*N - RPP8*
lcl|Contig16483		tag67299	tag104226	*N - RPS4*
lcl|Contig12054	tag48421	tag42039		*P*
lcl|Contig12187	tag36972	tag50989	tag78380	*P*
	tag30065	tag32071	tag40997	*P*
	tag19505	tag26545	tag15140	*P*
	tag756	tag26074	tag13636	*P*
	tag73963	tag17130	tag47707	*P*
	tag68238	tag17037		*P*
	tag37283	tag59263		*P*
	tag11910	tag32371		*P*
	tag65938	tag10539		*P*
		tag57202		*P*
		tag64266		*P*
		tag37767		*P*
		tag11434		*P*
lcl|Contig12243	tag9111	tag8025		*P*
		tag34829		*P*
lcl|Contig20164	tag56020			*P*
lcl|Contig20542	tag23749	tag67128	tag16548	*P*
		tag20654		*P*
		tag4241		*P*
lcl|Contig21287	tag9111	tag8025		*P*
		tag34829		*P*
		tag69732		*P*
lcl|Contig21292	tag48643	tag28096		*P*
	tag32403			*P*
lcl|Contig24379	tag59208	tag51376		*P*
lcl|Contig9298	tag23749	tag20654	tag16548	*P*
		tag4241		*P*
lcl|Contig9530		tag67128		*P*
				P
lcl|Contig9674	tag15887	tag13863		*P*
lcl|SJ05-E1-H04-017-E08-UC.F	tag23749	tag67128	tag16548	*P*
	tag19547	tag20654	tag13666	*P*
		tag17064		*P*
		tag4241		*P*
lcl|Contig13034	tag69787	tag60583	tag84513	*PBS1*
	tag60044			*PBS1*
	tag30513			*PBS1*
lcl|Contig16308	tag39813	tag34550		*PBS1*
	tag34147			*PBS1*

lcl|Contig1973	tag65347	tag56712		*PBS1*
lcl|Contig24527			tag673	*PBS1*
lcl|Contig26006	tag51828	tag70381	tag88473	*PBS1*
	tag19589	tag44964	tag66196	*PBS1*
	tag75388	tag65516	tag52718	*PBS1*
lcl|Contig26953	tag29470	tag25546	tag20645	*PBS1*
lcl|SJ01-E1-L06-026-D07-UC.F	tag16513		tag82274	*PBS1*
			tag64005	*PBS1*
lcl|Contig12233	tag65347	tag56712		*PBS1 - Pti1*
lcl|Contig11191	tag68304	tag59322	tag102746	*PBS1 - Pti5*
	tag36995	tag63598	tag99849	*PBS1 - Pti5*
	tag20664			*PBS1 - Pti5*
lcl|Contig19331	tag54258			*Pib - Pti*
lcl|Contig8566	tag65654	tag43457	tag47690	*Pti*
	tag68203	tag59235		*Pti*
lcl|Contig18806	tag68297	tag29464	tag89951	*Pti - Pto*
	tag33967	tag16752	tag23752	*Pti - Pto*
	tag19170		tag13408	*Pti - Pto*
	tag53482			*Pti - Pto*
lcl|Contig18043	tag42434	tag36856	tag82152	*Pti1 - PBS1*
	tag36211	tag31428	tag77848	*Pti1 - PBS1*
			tag36512	*Pti1 - PBS1*
lcl|Contig5248	tag65438		tag97766	*Pti1 - PBS1*
lcl|Contig5325	tag35672	tag30956	tag24951	*Pti1 - PBS1*
lcl|Contig5428	tag14256	tag12470	tag10076	*Pti1 - PBS1*
lcl|Contig5446	tag47493			*Pti1 - PBS1*
lcl|Contig5479	tag28907	tag25082	tag72765	*Pti1 - PBS1*
lcl|Contig9659	tag18508	tag16190		*Pti1 - PBS1*
				Pti1 - PBS1
lcl|SJ01-E1-S04-009-G09-UC.F	tag56203	tag48800		*Pti1 - PBS1*
lcl|Contig10922	tag73010	tag63442	tag51008	*Pti1 - Pti4 - Pti5*
lcl|Contig22944	tag57208			*Pti1 - Pto*
lcl|Contig23024	tag71030	tag61649	tag14165	*Pti1 - Pto*
	tag20240	tag17677	tag58806	*Pti1 - Pto*
	tag13804	tag12100		*Pti1 - Pto*
	tag8847	tag7780		*Pti1 - Pto*
lcl|Contig23186	tag20622	tag18013		*Pti1 - Pto*
	tag38091	tag33072		*Pti1 - Pto*
lcl|Contig24566	tag87804	tag51709		*Pti1 - Pto*
	tag77121			*Pti1 - Pto*
	tag80905			*Pti1 - Pto*
lcl|Contig26704	tag81368	tag72860	tag95721	*Pti1 - Pto*
	tag62453	tag56626		*Pti1 - Pto*
	tag4449	tag54219		*Pti1 - Pto*

		tag51087		*Pti1 - Pto*
lcllContig14340	tag28415	tag24657	tag49052	*Pti1 - Pto - PBS1*
			tag19903	*Pti1 - Pto - PBS1*
lcllContig10666	tag636	tag548	tag449	*Pti4 - Pti5 - Pti6*
lcllContig10732	tag72398	tag62906	tag102657	*Pti4 - Pti5 - Pti6*
	tag13073	tag11544	tag61772	*Pti4 - Pti5 - Pti6*
	tag8508	tag11436	tag58017	*Pti4 - Pti5 - Pti6*
	tag12943		tag61679	*Pti4 - Pti5 - Pti6*
lcllContig11904	tag84859			*Pti4 - Pti5 - Pti6*
lcllContig12169	tag78543	tag37506		*Pti4 - Pti5 - Pti6*
	tag59027	tag28883		*Pti4 - Pti5 - Pti6*
	tag43182			*Pti4 - Pti5 - Pti6*
lcllContig12202	tag49374	tag38260	tag83233	*Pti4 - Pti5 - Pti6*
	tag44044			*Pti4 - Pti5 - Pti6*
	tag12951			*Pti4 - Pti5 - Pti6*
lcllContig15957	tag45943	tag39903	tag84534	*Pti4 - Pti5 - Pti6*
		tag35382		*Pti4 - Pti5 - Pti6*
lcllContig16018	tag37331	tag32411	tag26116	*Pti4 - Pti5 - Pti6*
lcllContig16116	tag48744	tag42322	tag86465	*Pti4 - Pti5 - Pti6*
lcllContig16201	tag65324		tag97692	*Pti4 - Pti5 - Pti6*
lcllContig16657	tag15068	tag66826	tag59765	*Pti4 - Pti5 - Pti6*
	tag10248	tag9035	tag73146	*Pti4 - Pti5 - Pti6*
	tag5088	tag987		*Pti4 - Pti5 - Pti6*
	tag1165	tag25573		*Pti4 - Pti5 - Pti6*
	tag29504			*Pti4 - Pti5 - Pti6*
lcllContig18308	tag70031	tag60775	tag56018	*Pti4 - Pti5 - Pti6*
	tag8387	tag4177		*Pti4 - Pti5 - Pti6*
	tag4765			*Pti4 - Pti5 - Pti6*
	tag79780			*Pti4 - Pti5 - Pti6*
lcllContig20693	tag63945	tag55497	tag44713	*Pti4 - Pti5 - Pti6*
	tag43075	tag43457		*Pti4 - Pti5 - Pti6*
lcllContig20781	tag49744	tag43176	tag87137	*Pti4 - Pti5 - Pti6*
	tag28744	tag5756	tag10606	*Pti4 - Pti5 - Pti6*
	tag15025			*Pti4 - Pti5 - Pti6*
lcllContig20941	tag35833			*Pti4 - Pti5 - Pti6*
lcllContig21955	tag19460	tag29824	tag13608	*Pti4 - Pti5 - Pti6*
lcllContig24361	tag65573	tag56904	tag99212	*Pti4 - Pti5 - Pti6*
	tag2305	tag2019	tag54359	*Pti4 - Pti5 - Pti6*
lcllContig24917	tag42024	tag36503	tag54061	*Pti4 - Pti5 - Pti6*
	tag35790	tag31059	tag25038	*Pti4 - Pti5 - Pti6*
	tag1863	tag40490	tag17690	*Pti4 - Pti5 - Pti6*
	tag46641		tag84983	*Pti4 - Pti5 - Pti6*
			tag50199	*Pti4 - Pti5 - Pti6*
			tag81868	*Pti4 - Pti5 - Pti6*

lcl|Contig24996	tag20004	tag17469	tag87103	*Pti4 - Pti5 - Pti6*
			tag14004	*Pti4 - Pti5 - Pti6*
lcl|Contig27279	tag51405	tag44601	tag35914	*Pti4 - Pti5 - Pti6*
lcl|Contig27359	tag53036		tag36994	*Pti4 - Pti5 - Pti6*
lcl|Contig2826	tag56521	tag49059	tag91709	*Pti4 - Pti5 - Pti6*
	tag17519	tag15292	tag64709	*Pti4 - Pti5 - Pti6*
lcl|Contig2822			tag98112	*Pti4 - Pti5 - Pti6*
lcl|Contig28585	tag84479	tag20526	tag82999	*Pti4 - Pti5 - Pti6*
	tag19247	tag16813	tag69035	*Pti4 - Pti5 - Pti6*
	tag2127	tag1870	tag13462	*Pti4 - Pti5 - Pti6*
			tag1568	*Pti4 - Pti5 - Pti6*
lcl|Contig28754	tag41602	tag36135		*Pti4 - Pti5 - Pti6*
lcl|Contig29354	tag69734	tag60535	tag48726	*Pti4 - Pti5 - Pti6*
	tag15949	tag13923	tag11201	*Pti4 - Pti5 - Pti6*
		tag66963	tag18657	*Pti4 - Pti5 - Pti6*
lcl|Contig3013	tag9913			*Pti4 - Pti5 - Pti6*
lcl|Contig3053	tag42486	tag36902	tag77044	*Pti4 - Pti5 - Pti6*
	tag35055	tag30439	tag29743	*Pti4 - Pti5 - Pti6*
lcl|Contig3063	tag11990			*Pti4 - Pti5 - Pti6*
lcl|Contig7033	tag65324		tag97692	*Pti4 - Pti5 - Pti6*
			tag79858	*Pti4 - Pti5 - Pti6*
lcl|Contig7365	tag31798	tag25573	tag73146	*Pti4 - Pti5 - Pti6*
	tag29504		tag66751	*Pti4 - Pti5 - Pti6*
	tag20318		tag59765	*Pti4 - Pti5 - Pti6*
lcl|SJ01-E1-SH2-103-B06-UC.F	tag67112	tag58263	tag77044	*Pti4 - Pti5 - Pti6*
	tag63621	tag55217		*Pti4 - Pti5 - Pti6*
	tag35055	tag30439		*Pti4 - Pti5 - Pti6*
lcl|Contig16264	tag70557	tag61242		*Pti4 - Pti5 - Pti6 - PBS1*
lcl|Contig1472	tag6028	tag5310	tag56877	*Pti5 - PBS1*
	tag2842			*Pti5 - PBS1*
lcl|Contig15071	tag45093	tag39145	tag97510	*Pti5 - PBS1*
	tag4166	tag3630	tag83910	*Pti5 - PBS1*
			tag64874	*Pti5 - PBS1*
			tag55588	*Pti5 - PBS1*
lcl|Contig15350		tag97876		*Pti5 - PBS1*
lcl|Contig1639	tag85136	tag57113	tag98072	*Pti5 - PBS1*
	tag65821	tag24244		*Pti5 - PBS1*
	tag27974			*Pti5 - PBS1*
lcl|Contig16504	tag82243	tag10354	tag60812	*Pti5 - PBS1*
			tag52045	*Pti5 - PBS1*
			tag15819	*Pti5 - PBS1*
lcl|Contig16651	tag55962	tag48579	tag58208	*Pti5 - PBS1*
	tag7946	tag6975	tag39153	*Pti5 - PBS1*
	tag48272	tag41920	tag86137	*Pti5 - PBS1*

lcl|Contig13328	tag72398	tag62906	tag102657	*Pti5 - Pti6*
	tag12943	tag23601	tag61679	*Pti5 - Pti6*
	tag13073	tag11436	tag61772	*Pti5 - Pti6*
		tag11544		*Pti5 - Pti6*
lcl|Contig1712	tag88785			*Pti5 - Pti6*
lcl|Contig17311		tag70159	tag104195	*Pti5 - Pti6*
		tag64913		*Pti5 - Pti6*
lcl|Contig17807	tag61503	tag53357	tag42964	*Pti5 - Pti6*
	tag5098			*Pti5 - Pti6*
				Pti5 - Pti6
lcl|Contig1937	tag65097	tag56504	tag97521	*Pti5 - Pti6*
lcl|Contig23305		tag67528		*Pti5 - Pti6*
lcl|Contig16780	tag63498	tag55095	tag44388	*Pti5 - Pti6 -Pti1*
	tag79750		tag13476	*Pti5 - Pti6 -Pti1*
				Pti5 - Pti6 -Pti1
lcl|Contig16894	tag28140	tag24407	tag72239	*Pti5 - Pti6 -Pti1*
	tag76706			*Pti5 - Pti6 -Pti1*
lcl|Contig16984	tag30079	tag26087	tag73560	*Pti5 - Pti6 -Pti1*
lcl|Contig1703	tag14743	tag12888	tag35038	*Pti5 - Pti6 -Pti1*
	tag50119			*Pti5 - Pti6 -Pti1*
lcl|Contig12383	tag12991		tag9273	*Pti5 - Pto*
lcl|Contig12416	tag11313	tag10028		*Pti5 - Pto*
lcl|Contig12431	tag72392	tag62900	tag34911	*Pti5 - Pto - PBS1*
	tag49941			*Pti5 - Pto - PBS1*
	tag26879			*Pti5 - Pto - PBS1*
lcl|Contig13901	tag14651			*Pti5 - Pto - PBS1*
lcl|Contig13987	tag43067			*Pti5 - Pto - PBS1*
lcl|Contig13974		tag56049		*Pti5 - Pto - PBS1*
lcl|Contig12319	tag35530	tag30836	tag77372	*Pti6*
lcl|Contig16476			tag89038	*Pti6*
lcl|Contig18617	tag34468	tag29910	tag76615	*Pti6*
			tag49769	*Pti6*
lcl|Contig26930	tag33000	tag28615	tag75653	*Pti6*
	tag2620			*Pti6*
lcl|Contig329	tag71080	tag11940	tag101738	*Pti6*
	tag13592		tag62100	*Pti6*
			tag53328	*Pti6*
			tag1698	*Pti6*
lcl|Contig3494	tag52447	tag45482	tag10156	*Pti6*
lcl|Contig3532	tag63476		tag44368	*Pti6*
lcl|Contig3736	tag43388	tag6052		*Pti6*
	tag6873	tag18417		*Pti6*
lcl|Contig3750	tag82562		tag54404	*Pti6*
lcl|Contig4658	tag70031	tag60775	tag93886	*Pti6*

	tag65310	tag51927	tag57659	*Pti6*
	tag59835	tag28827		*Pti6*
lcl|Contig7932	tag20608	tag18002	tag14427	*Pti6*
lcl|Contig18526	tag83666	tag16991	tag13597	*Pto*
	tag36805			*Pto*
	tag19442			*Pto*
lcl|Contig754	tag49822	tag41063	tag33100	*Pto*
	tag47308	tag35684	tag28724	*Pto*
	tag41094	tag29051	tag23422	*Pto*
	tag33523			*Pto*
	tag74073			*Pto*
lcl|SJ01-E1-F02-014-G08-UC.F	tag48714	tag42296		*Pto*
lcl|SJ01-E1-L02-003-B01-UC.F	tag65615		tag45895	*Pto*
lcl|SJ01-E1-L08-096-F09-UC.F	tag13189			*Pto*
lcl|SJ01-E1-L08-167-A07-UC.F	tag41909	tag36412		*Pto*
lcl|Contig14085	tag48587	tag42186	tag33960	*Pto - PBS1*
			tag27211	*Pto - PBS1*
lcl|Contig1867	tag8962	tag7891	tag58899	*Pto - PBS1*
lcl|SJ10-E1-R05-031-A03-UC.F	tag40224			*Pto - Pti1 -PBS1*
lcl|Contig21418		tag41301	tag75308	*Pto - Pti6*
lcl|Contig24612	tag51253		tag88107	*RAR1*
lcl|Contig27196	tag51253	tag44460	tag88107	*RAR1*
	tag15558		tag10923	*RAR1*
lcl|Contig1149		tag27942	tag1207	*RIN4*
			tag384	*RIN4*
lcl|Contig13859	tag84767			*RIN4*
lcl|Contig20845	tag74439	tag64684	tag104044	*RIN4*
lcl|Contig20845	tag51318	tag44520	tag88145	*RIN4*
			tag507	*RIN4*
lcl|Contig10273	tag34645		tag92989	*RPP13 - PRF - RPM1 - BS2 - RX1 -GPA2*
lcl|Contig1759	tag61299	tag53192	tag94960	*RPS4 - Hrt*
	tag33574	tag29103	tag43656	*RPS4 - Hrt*
			tag76033	*RPS4 - Hrt*
lcl|Contig5517	tag27730		tag60974	*RPS4 - Xa1 -I2 -RP1*
	tag13076			*RPS4 - Xa1 -I2 -RP1*
	tag11918			*RPS4 - Xa1 -I2 -RP1*
lcl|Contig13135	tag71272	tag43983	tag49777	*RRS1*
	tag50689	tag16251	tag35426	*RRS1*
			tag12985	*RRS1*
lcl|Contig1553	tag7629	tag6719	tag57985	*RRS1*
lcl|Contig16492	tag87160	tag50839	tag93039	*RRS1*
	tag58591	tag16753	tag57830	*RRS1*
	tag19173	tag6525	tag13411	*RRS1*
	tag14135			*RRS1*

	tag7399			*RRS1*
lcl|Contig17059	tag56807	tag49321		*RRS1*
		tag29364		*RRS1*
lcl|Contig20831			tag29290	*RRS1*
lcl|Contig29142	tag49042	tag42577	tag34281	*RRS1*
lcl|Contig3057	tag71180			*RRS1*
lcl|Contig3205	tag6721	tag5909	tag57365	*RRS1*
lcl|Contig3637	tag27335	tag23718	tag71665	*RRS1*
		tag12255	tag48154	*RRS1*
lcl|Contig5209	tag59411	tag71290	tag41483	*RRS1*
		tag51544		*RRS1*
lcl|Contig5710	tag59411	tag71290	tag78424	*RRS1*
	tag37045	tag51544	tag41483	*RRS1*
	tag10020	tag32146	tag7092	*RRS1*
	tag4991	tag8845	tag3545	*RRS1*
		tag4391		*RRS1*
lcl|Contig6095	tag69699	tag74639	tag48703	*RRS1*
	tag65770	tag60506	tag13003	*RRS1*
	tag28916	tag57077		*RRS1*
	tag18600	tag25090		*RRS1*
		tag16266		*RRS1*
		tag72971		*RRS1*
lcl|Contig7012	tag45540	tag39538	tag84252	*RRS1*
	tag28666	tag30210		*RRS1*
	tag1210	tag29364		*RRS1*
		tag24898		*RRS1*
lcl|Contig7418			tag25579	*RRS1*
lcl|Contig7686	tag51932	tag45055	tag88549	*RRS1*
lcl|Contig7998	tag56088	tag48700	tag91420	*RRS1*
			tag71982	*RRS1*
			tag20605	*RRS1*
lcl|Contig9906		tag21600		*RRS1*
lcl|SJ01-E1-S08-009-G01-UC.F	tag27154		tag71553	*RRS1*
lcl|SJ01-E1-S08-033-F04-UC.F	tag6794	tag66617	tag57419	*RRS1*
		tag5982	tag2944	*RRS1*
lcl|SJ07-E1-S10-278-B02-UC.F	tag15148	tag13106	tag63097	*RRS1*
	tag15020	tag26229	tag10601	*RRS1*
lcl|SJ08-E1-F03-032-F04-UC.F		tag74525		*RRS1*
lcl|SJ09-E1-R06-028-A06-UC.F	tag25235	tag21931		*RRS1*
lcl|SJ10-E1-R05-012-B04-UC.F	tag38375			*RRS1 - N*
lcl|Contig18518	tag71343	tag19772		*RRS1 - WRKY25*
lcl|Contig10629	tag88539	tag58707	tag99363	*RRS1 - WRKY25 -WRKY33*
	tag79577	tag38531	tag82448	*RRS1 - WRKY25 -WRKY33*
	tag42863	tag37227		*RRS1 - WRKY25 -WRKY33*

		tag66981		*RRS1 - WRKY25 -WRKY33*
lcl|Contig12608	tag47776		tag85785	*RRS1 - WRKY25 -WRKY33*
lcl|Contig16939	tag31832			*RX1 - RPP8*
lcl|Contig1110	tag54197	tag47080	tag90162	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
	tag42036	tag25692	tag59552	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
	tag34479	tag7971	tag20760	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
	tag29626		tag6419	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
	tag9926		tag57530	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
	tag9058			*RX1 - RPP8 - GPA2 -RPS5-RPM4*
	tag6250			*RX1 - RPP8 - GPA2 -RPS5-RPM4*
lcl|Contig3286	tag25741			*WRKY25 - WRKY29 - WRKY33*
lcl|Contig3348	tag63886	tag55445	tag93328	*WRKY25 - WRKY29 - WRKY33*
	tag59019	tag51212	tag54825	*WRKY25 - WRKY29 - WRKY33*
lcl|Contig23005	tag20743	tag18109	tag14518	*WRKY25 - WRKY29 - WRKY33 -RRS1*
lcl|Contig23015	tag83980	tag55254	tag64923	*WRKY25 - WRKY29 - WRKY33 -RRS1*
	tag22154	tag19317		*WRKY25 - WRKY29 - WRKY33 -RRS1*
lcl|Contig26942	tag64011			*WRKY25 - WRKY29 - WRKY33 -RRS1*
lcl|Contig5035	tag57928	tag50281		*WRKY25 - WRKY29 - WRKY33 - RRS1*
		tag43611		*WRKY25 - WRKY29 - WRKY33 - RRS1*
lcl|Contig26670	tag75266	tag65424	tag104597	*WRKY25 - WRKY33*
	tag70098			*WRKY25 - WRKY33*
	tag35648			*WRKY25 - WRKY33*
	tag26852			*WRKY25 - WRKY33*
lcl|Contig16225	tag76779		tag42860	*WRKY25 - WRKY33 - RRS1*
			tag27517	*WRKY25 - WRKY33 - RRS1*
			tag9803	*WRKY25 - WRKY33 - RRS1*
lcl|Contig18831	tag65770	tag70862	tag60648	*WRKY25 - WRKY33 - RRS1*
	tag11468	tag67186	tag61802	*WRKY25 - WRKY33 - RRS1*
	tag69699	tag60039	tag48703	*WRKY25 - WRKY33 - RRS1*
	tag45416	tag57077	tag37864	*WRKY25 - WRKY33 - RRS1*
		tag10171		*WRKY25 - WRKY33 - RRS1*
		tag60506		*WRKY25 - WRKY33 - RRS1*
		tag47133		*WRKY25 - WRKY33 - RRS1*
lcl|Contig21048	tag21300	tag4522	tag3646	*WRKY25 - WRKY33 -RRS1*
	tag5126	tag36159	tag46995	*WRKY25 - WRKY33 -RRS1*
	tag41632		tag29090	*WRKY25 - WRKY33 -RRS1*
lcl|Contig2139	tag63593	tag45592	tag85913	*WRKY25 - WRKY33 -RRS1*
	tag47928	tag41604	tag80007	*WRKY25 - WRKY33 -RRS1*
	tag39309	tag34132	tag64564	*WRKY25 - WRKY33 -RRS1*
	tag17329		tag1237	*WRKY25 - WRKY33 -RRS1*
	tag1697			*WRKY25 - WRKY33 -RRS1*
lcl|Contig23415	tag26035	tag22617	tag70732	*WRKY25 - WRKY33 -RRS1*
lcl|SJ01-E1-L08-104-F11-UC.F		tag37370		*WRKY33*
lcl|Contig11275	tag85459	tag60039		*WRKY33 - WRKY25 - WRKY29*

lcl|Contig1149	tag32246	tag27942	tag75119	*WRKY33 - WRKY25 - WRKY29*
	tag81717		tag1207	*WRKY33 - WRKY25 - WRKY29*
	tag510		tag384	*WRKY33 - WRKY25 - WRKY29*
lcl|Contig1193	tag66871	tag58034	tag46761	*WRKY33 - WRKY25 - WRKY29 - RRS1*
lcl|Contig12175	tag86738	tag28270	tag22826	*WRKY33 - WRKY25 - WRKY29 - RRS1*
	tag86738			*WRKY33 - WRKY25 - WRKY29 - RRS1*
	tag32590			*WRKY33 - WRKY25 - WRKY29 - RRS1*
	tag86532			*WRKY33 - WRKY25 - WRKY29 - RRS1*
lcl|Contig1863	tag50494	tag29167	tag23513	*Xa1*
	tag33650			*Xa1*
lcl|Contig8174	tag13435		tag9551	*Xa1*
lcl|Contig21003	tag49155	tag42672	tag86739	*Xa1 - I2 - RP1*

Table S4 - Number of tag and of repetitions in all three comparisons matching *R* and *PR* genes. Comparisons regard: (1) Embrapa-48, drought tolerant stressed *vs.* negative control; (2) BR-16, drought susceptible stressed *vs.* negative control and (3) PI561356 fungus resistant stressed *vs.* negative control).

TAG	Comparison 1	Comparison 2	Comparison 3	Gene
tag68862	1	-	-	*PR1*
tag59808	-	1	-	*PR1*
tag63365	-	1	-	*PR1*
tag36506	1	-	-	*PR2*
tag11357	1	-	-	*PR2*
tag46409	1	-	-	*PR2*
tag32168	1	-	-	*PR2*
tag68310	1	-	-	*PR2*
tag44889	1	-	-	*PR2*
tag9100	1	-	-	*PR2*
tag45846	1	-	-	*PR2*
tag25841	1	-	-	*PR2*
tag82314	1	-	-	*PR2*
tag56871	1	-	-	*PR2*
tag27708	1	-	-	*PR2*
tag8887	1	-	-	*PR2*
tag59047	1	-	-	*PR2*
tag12216	1	-	-	*PR2*
tag37813	1	-	-	*PR2*
tag10066	-	1	-	*PR2*
tag39145	-	1	-	*PR2*
tag3630	-	1	-	*PR2*
tag59329	-	1	-	*PR2*
tag38968	-	1	-	*PR2*
tag25980	-	1	-	*PR2*
tag8419	-	1	-	*PR2*
tag8014	-	1	-	*PR2*
tag1466	-	1	-	*PR2*
tag49381	-	1	-	*PR2*
tag24029	-	1	-	*PR2*
tag51236	-	1	-	*PR2*
tag10804	-	1	-	*PR2*
tag66054	-	1	-	*PR2*
tag32848	-	1	-	*PR2*
tag78070	-	-	1	*PR2*
tag60582	-	-	1	*PR2*
tag79022	-	-	1	*PR2*

tag84826	-	-	1	*PR2*
tag22491	-	-	1	*PR2*
tag99853	-	-	1	*PR2*
tag65175	-	-	2	*PR2*
tag31437	-	-	1	*PR2*
tag20988	-	-	1	*PR2*
tag90186	-	-	1	*PR2*
tag57103	-	-	1	*PR2*
tag55954	-	-	1	*PR2*
tag78351	-	-	1	*PR2*
tag44671	-	-	2	*PR2*
tag15360	-	-	1	*PR2*
tag85817	-	-	1	*PR2*
tag84463	-	-	1	*PR2*
tag6497	1	-	-	*PR3*
tag84062	1	-	-	*PR3*
tag46904	2	-	-	*PR3*
tag24957	2	-	-	*PR3*
tag40898	1	-	-	*PR3*
tag16468	-	1	-	*PR3*
tag40711	-	2	-	*PR3*
tag21694	-	2	-	*PR3*
tag65653	-	-	1	*PR3*
tag85166	-	-	3	*PR3*
tag69947	-	-	2	*PR3*
tag3237	1	1	-	*PR4*
tag2342	-	-	1	*PR4*
tag11624	1	-	-	*PR5*
tag68146	1	-	-	*PR5*
tag36545	2	-	-	*PR5*
tag39153	3	-	-	*PR5*
tag72021	2	-	-	*PR5*
tag59796	1	-	-	*PR5*
tag88038	1	-	-	*PR5*
tag18502	1	-	-	*PR5*
tag34943	1	-	-	*PR5*
tag43928	1	-	-	*PR5*
tag54332	1	-	-	*PR5*
tag6303	1	-	-	*PR5*
tag40848	1	-	-	*PR5*
tag13755	1	-	-	*PR5*
tag54405	1	-	-	*PR5*
tag10308	-	1	-	*PR5*
tag59923	-	1	-	*PR5*

tag59192	-	1	-	*PR5*
tag42604	-	1	-	*PR5*
tag33990	-	2	-	*PR5*
tag62569	-	2	-	*PR5*
tag51894	-	1	-	*PR5*
tag30354	-	1	-	*PR5*
tag38158	-	1	-	*PR5*
tag59695	-	1	-	*PR5*
tag43008	-	1	-	*PR5*
tag5543	-	1	-	*PR5*
tag43561	-	1	-	*PR5*
tag35455	-	1	-	*PR5*
tag37529	-	1	-	*PR5*
tag47268	-	1	-	*PR5*
tag99740	-	-	1	*PR5*
tag83791	-	-	1	*PR5*
tag34308	-	-	1	*PR5*
tag102419	-	-	2	*PR5*
tag86894	-	-	2	*PR5*
tag93861	-	-	1	*PR5*
tag95623	-	-	2	*PR5*
tag11057	-	-	1	*PR5*
tag52864	-	-	1	*PR5*
tag24460	-	-	2	*PR5*
tag23570	-	-	1	*PR6*
tag73367	1	-	-	*PR7*
tag42520	1	-	-	*PR7*
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tag50867	2			*FLS2 - EFR - Xa21 - Cf9*
tag4885	1	-	-	*FLS2 - EFR - Xa21 - Cf9*
tag43120	1	-	-	*FLS2 - EFR - Xa21 - Cf9*
tag16689	-	2	-	*FLS2 - EFR - Xa21 - Cf9*
tag55838	-	1	-	*FLS2 - EFR - Xa21 - Cf9*
tag45347	-	1	-	*FLS2 - EFR - Xa21 - Cf9*
tag35941	-	1	-	*FLS2 - EFR - Xa21 - Cf9*
tag56626	-	2	-	*FLS2 - EFR - Xa21 - Cf9*
tag51087	-	2	-	*FLS2 - EFR - Xa21 - Cf9*
tag44130	-	2	-	*FLS2 - EFR - Xa21 - Cf9*
tag4286	-	1	-	*FLS2 - EFR - Xa21 - Cf9*
tag65861	-	-	3	*FLS2 - EFR - Xa21 - Cf9*
tag34866	-	-	3	*FLS2 - EFR - Xa21 - Cf9*
tag45002	-	-	1	*FLS2 - EFR - Xa21 - Cf9*
tag88790	-	-	1	*FLS2 - EFR - Xa21 - Cf9*
tag81414	-	-	1	*FLS2 - EFR - Xa21 - Cf9*
tag27957	-	-	1	*FLS2 - EFR - Xa21 - Cf9*
tag53258	-	-	1	*FLS2 - EFR - Xa21 - Cf9*
tag87863	-	-	2	*FLS2 - EFR - Xa21 - Cf9*
tag937	1	-	-	*FLS2 - EFR - Xa21 - Cf9 - Pto*
tag805	-	1	-	*FLS2 - EFR - Xa21 - Cf9 - Pto*
tag673	-	-	1	*FLS2 - EFR - Xa21 - Cf9 - Pto*
tag8154	1	-	1	*FLS2 - EFR - Xa21 - PBS1*
tag5809	-	-	1	*FLS2 - EFR - Xa21 - PBS1*
tag88766	1	-	-	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
tag37224	1	-	-	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
tag61118	-	1	-	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
tag2120	-	1	-	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
tag101294	-	-	1	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
tag77869	-	-	1	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
tag17477	-	-	1	*FLS2 - EFR - Xa21 - Pti1 -PBS1*
tag80835	1	-	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag20485	1	-	-	*FLS2 - EFR - Xa21 - Pto - PBS1*

tag23653	1	-	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag65160	-	1	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag352	-	1	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag17895	-	1	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag72626	-	1	-	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag41621	-	-	1	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag84995	-	-	2	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag66883	-	-	1	*FLS2 - EFR - Xa21 - Pto - PBS1*
tag2305	2	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag50530	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag40752	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag73463	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag56636	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag58111	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag13460	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag12945	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag14701	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag48584	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag65387	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag20522	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag20580	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag2019	-	2	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag63860	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag49167	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag50448	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag35449	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag72860	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag54219	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag12850	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag42184	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag56745	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag17926	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag43417	-	-	2	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag54359	-	-	2	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag11508	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag103383	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag91780	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag40543	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag9568	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag40814	-	-	2	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag34803	-	-	1	*FLS2 - EFR - Xa21 - Pto - Pti1*
tag61503	2	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag24605	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag10857	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*

tag25422	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag16513	2	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag53215	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag54724	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag7075	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag3336	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag20344	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag50204	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag27810	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag66853	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag64930	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag23567	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag70967	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag3393	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag5588	1	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag21525	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag60066	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag16851	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag47034	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag73199	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag53689	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag59198	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag48211	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag18953	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag27199	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag70416	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag63444	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag41197	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag26621	1	-	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag53357	-	2	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag9592	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag22117	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag46170	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag47375	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag6240	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag17765	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag43583	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag24118	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag58012	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag56360	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag26781	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag2999	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag4935	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag10258	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*

tag18771	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag52127	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag14685	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag40838	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag63615	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag16568	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag23595	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag61119	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag55047	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag35774	-	1	-	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag42964	-	-	2	*FLS2 - EFR - Xa21 - Pto - Pti1 -PBS1*
tag50646	1	-	-	*FSL2 - EFR - Xa21*
tag32878	1	-	-	*FSL2 - EFR - Xa21*
tag18088	1	-	-	*FSL2 - EFR - Xa21*
tag5606	1	1	-	*FSL2 - EFR - Xa21*
tag61123	1	-	-	*FSL2 - EFR - Xa21*
tag45193	1	-	-	*FSL2 - EFR - Xa21*
tag43942	1	-	-	*FSL2 - EFR - Xa21*
tag28517	1	-	-	*FSL2 - EFR - Xa21*
tag15813	-	1	-	*FSL2 - EFR - Xa21*
tag4953	-	1	-	*FSL2 - EFR - Xa21*
tag53049	-	1	-	*FSL2 - EFR - Xa21*
tag39246	-	1	-	*FSL2 - EFR - Xa21*
tag87686	-	-	1	*FSL2 - EFR - Xa21*
tag75578	-	-	1	*FSL2 - EFR - Xa21*
tag12666	-	-	1	*FSL2 - EFR - Xa21*
tag102522	-	-	1	*FSL2 - EFR - Xa21*
tag79682	-	-	1	*FSL2 - EFR - Xa21*
tag45396	-	-	1	*FSL2 - EFR - Xa21*
tag84003	-	-	1	*FSL2 - EFR - Xa21*
tag35320	1	-	-	*FSL2 - EFR - Xa21-Cf2*
tag30654	-	1	-	*FSL2 - EFR - Xa21-Cf2*
tag77218	-	-	1	*FSL2 - EFR - Xa21-Cf2*
tag54197	2	-	-	*I2*
tag34479	2	-	-	*I2*
tag6250	2	-	-	*I2*
tag67743	1	-	-	*I2*
tag32262	1	-	-	*I2*
tag23311	1	-	-	*I2*
tag19077	1	-	-	*I2*
tag14346	1	-	-	*I2*
tag12798	1	-	-	*I2*
tag47080	-	2	-	*I2*
tag51933	-	1	-	*I2*

tag31204	-	1	-	*I2*
tag27961	-	1	-	*I2*
tag20278	-	1	-	*I2*
tag16677	-	1	-	*I2*
tag12550	-	1	-	*I2*
tag11334	-	1	-	*I2*
tag90162	-	-	2	*I2*
tag93890	-	-	1	*I2*
tag62560	-	-	1	*I2*
tag13358	-	-	1	*I2*
tag75887	-	-	1	*I2*
tag51514	-	1	-	*I2 - RP1*
tag23934	1	-	-	*N*
tag9297	1	-	-	*N*
tag20817	-	1	-	*N*
tag67059	-	1	-	*N*
tag30235	2	-	-	*N - HERO*
tag26215	-	2	-	*N - HERO*
tag21179	-	-	2	*N - HERO*
tag70875	-	-	1	*N - HERO*
tag71759	1	-	-	*N - Hrt*
tag62327	-	1	-	*N - Hrt*
tag45832	-	1	-	*N - Hrt*
tag50150	-	-	1	*N - Hrt*
tag36876	-	-	1	*N - Hrt*
tag58736	2	-	-	*N - Hrt - RPS4*
tag66150	1	-	-	*N - Hrt - RPS4*
tag20254	1	-	-	*N - Hrt - RPS4*
tag72756	1	-	-	*N - Hrt - RPS4*
tag7629	1	-	-	*N - Hrt - RPS4*
tag50972	-	2	-	*N - Hrt - RPS4*
tag28505	-	1	-	*N - Hrt - RPS4*
tag57390	-	1	-	*N - Hrt - RPS4*
tag17689	-	1	-	*N - Hrt - RPS4*
tag40989	-	-	2	*N - Hrt - RPS4*
tag10039	-	-	1	*N - Hrt - RPS4*
tag98302	-	-	1	*N - Hrt - RPS4*
tag66702	-	-	1	*N - Hrt - RPS4*
tag60967	1	-	-	*N - Hrt - RPS4 - RRS1*
tag52924	-	1	-	*N - Hrt - RPS4 - RRS1*
tag42587	-	-	1	*N - Hrt - RPS4 - RRS1*
tag47987	-	-	1	*N - RPP8*
tag101692	-	-	1	*N - RPP8*
tag67299	-	1	-	*N - RPS4*

tag104226	-	-	1	*N - RPS4*
tag82691	-	-	1	*N - RPS4*
tag48421	1	-	-	*P*
tag36972	1	-	-	*P*
tag30065	1	-	-	*P*
tag19505	1	-	-	*P*
tag756	1	-	-	*P*
tag73963	1	-	-	*P*
tag68238	1	-	-	*P*
tag37283	1	-	-	*P*
tag11910	1	-	-	*P*
tag65938	1	-	-	*P*
tag9111	2	-	-	*P*
tag56020	1	-	-	*P*
tag23749	3	-	-	*P*
tag48643	1	-	-	*P*
tag32403	1	-	-	*P*
tag59208	1	-	-	*P*
tag15887	1	-	-	*P*
tag19547	1	-	-	*P*
tag42039	-	1	-	*P*
tag50989	-	1	-	*P*
tag32071	-	1	-	*P*
tag26545	-	1	-	*P*
tag26074	-	1	-	*P*
tag17130	-	1	-	*P*
tag17037	-	1	-	*P*
tag59263	-	1	-	*P*
tag32371	-	1	-	*P*
tag10539	-	1	-	*P*
tag57202	-	1	-	*P*
tag64266	-	1	-	*P*
tag37767	-	1	-	*P*
tag11434	-	1	-	*P*
tag8025	-	2	-	*P*
tag34829	-	2	-	*P*
tag67128	-	3	-	*P*
tag20654	-	3	-	*P*
tag4241	-	3	-	*P*
tag69732	-	1	-	*P*
tag28096	-	1	-	*P*
tag51376	-	1	-	*P*
tag13863	-	1	-	*P*
tag17064	-	1	-	*P*

tag78380	-	-	1	*P*
tag40997	-	-	1	*P*
tag15140	-	-	1	*P*
tag13636	-	-	1	*P*
tag47707	-	-	1	*P*
tag16548	-	-	3	*P*
tag65347	2	-	-	*PBS1*
tag69787	1	-	-	*PBS1*
tag60044	1	-	-	*PBS1*
tag30513	1	-	-	*PBS1*
tag39813	1	-	-	*PBS1*
tag34147	1	-	-	*PBS1*
tag8847	2	-	1	*PBS1*
tag51828	1	-	-	*PBS1*
tag19589	1	-	-	*PBS1*
tag29470	1	-	-	*PBS1*
tag56712	-	2	-	*PBS1*
tag60583	-	1	-	*PBS1*
tag34550	-	1	-	*PBS1*
tag70381	-	1	-	*PBS1*
tag44964	-	2	-	*PBS1*
tag25546	-	1	-	*PBS1*
tag84513	-	-	1	*PBS1*
tag88473	-	-	1	*PBS1*
tag68304	1	-	-	*PBS1 - Pti5*
tag36995	1	-	-	*PBS1 - Pti5*
tag20664	1	-	-	*PBS1 - Pti5*
tag59322	-	1	-	*PBS1 - Pti5*
tag63598	-	1	-	*PBS1 - Pti5*
tag102746	-	-	1	*PBS1 - Pti5*
tag99849	-	-	1	*PBS1 - Pti5*
tag54258	1	-	-	*Pib - Pti*
tag65654	1	-	-	*Pti*
tag68203	1	-	-	*Pti*
tag43457	-	2	-	*Pti*
tag59235	-	1	-	*Pti*
tag68297	1	-	-	*Pti - Pto*
tag33967	2	-	-	*Pti - Pto*
tag19170	1	-	-	*Pti - Pto*
tag53482	1	-	-	*Pti - Pto*
tag29464	-	1	-	*Pti - Pto*
tag16752	-	1	-	*Pti - Pto*
tag89951	-	-	1	*Pti - Pto*
tag23752	-	-	1	*Pti - Pto*

tag13408	-	-	1	*Pti - Pto*
tag42434	1	-	-	*Pti1 - PBS1*
tag36211	1	-	-	*Pti1 - PBS1*
tag65438	1	-	-	*Pti1 - PBS1*
tag35672	2	-	-	*Pti1 - PBS1*
tag14256	1	-	-	*Pti1 - PBS1*
tag47493	1	-	-	*Pti1 - PBS1*
tag28907	1	-	-	*Pti1 - PBS1*
tag18508	1	-	-	*Pti1 - PBS1*
tag56203	1	-	-	*Pti1 - PBS1*
tag36856	-	1	-	*Pti1 - PBS1*
tag31428	-	1	-	*Pti1 - PBS1*
tag30956	-	1	-	*Pti1 - PBS1*
tag12470	-	2	-	*Pti1 - PBS1*
tag25082	-	1	-	*Pti1 - PBS1*
tag16190	-	1	-	*Pti1 - PBS1*
tag48800	-	1	-	*Pti1 - PBS1*
tag82152	-	-	1	*Pti1 - PBS1*
tag77848	-	-	1	*Pti1 - PBS1*
tag36512	-	-	1	*Pti1 - PBS1*
tag73010	1	-	-	*Pti1 - Pti4 - Pti5*
tag63442	-	1	-	*Pti1 - Pti4 - Pti5*
tag51008	-	-	1	*Pti1 - Pti4 - Pti5*
tag57208	1	-	-	*Pti1 - Pto*
tag71030	1	-	-	*Pti1 - Pto*
tag20240	2	-	-	*Pti1 - Pto*
tag13804	1	-	-	*Pti1 - Pto*
tag20622	1	-	-	*Pti1 - Pto*
tag38091	1	-	-	*Pti1 - Pto*
tag87804	1	-	-	*Pti1 - Pto*
tag77121	2	-	-	*Pti1 - Pto*
tag80905	1	-	-	*Pti1 - Pto*
tag62453	1	-	-	*Pti1 - Pto*
tag4449	1	-	-	*Pti1 - Pto*
tag61649	-	1	-	*Pti1 - Pto*
tag17677	-	1	-	*Pti1 - Pto*
tag12100	-	2	-	*Pti1 - Pto*
tag7780	-	1	-	*Pti1 - Pto*
tag18013	-	1	-	*Pti1 - Pto*
tag33072	-	1	-	*Pti1 - Pto*
tag51709	-	1	-	*Pti1 - Pto*
tag14165	-	-	1	*Pti1 - Pto*
tag58806	-	-	1	*Pti1 - Pto*
tag28415	1	-	-	*Pti1 - Pto - PBS1*

tag24657	-	1	-	*Pti1 - Pto - PBS1*
tag49052	-	-	1	*Pti1 - Pto - PBS1*
tag19903	-	-	1	*Pti1 - Pto - PBS1*
tag636	1	-	-	*Pti4 - Pti5 - Pti6*
tag72398	2	-	-	*Pti4 - Pti5 - Pti6*
tag13073	2	-	-	*Pti4 - Pti5 - Pti6*
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tag12943	2	-	-	*Pti4 - Pti5 - Pti6*
tag84859	1	-	-	*Pti4 - Pti5 - Pti6*
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tag76779	1	-	-	*Pti4 - Pti5 - Pti6*
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tag1165	1	-	-	*Pti4 - Pti5 - Pti6*
tag29504	2	-	-	*Pti4 - Pti5 - Pti6*
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tag28744	1	-	-	*Pti4 - Pti5 - Pti6*
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tag35833	1	-	-	*Pti4 - Pti5 - Pti6*
tag49155	1	-	1	*Pti4 - Pti5 - Pti6*
tag19460	1	-	-	*Pti4 - Pti5 - Pti6*
tag65573	1	-	-	*Pti4 - Pti5 - Pti6*
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tag35790	1	-	-	*Pti4 - Pti5 - Pti6*
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tag46641	1	-	-	*Pti4 - Pti5 - Pti6*
tag20004	1	-	-	*Pti4 - Pti5 - Pti6*
tag51405	2	-	-	*Pti4 - Pti5 - Pti6*
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tag63621	2	-	-	*Pti4 - Pti5 - Pti6*
tag548	-	1	-	*Pti4 - Pti5 - Pti6*
tag62906	-	2	-	*Pti4 - Pti5 - Pti6*
tag11544	-	2	-	*Pti4 - Pti5 - Pti6*
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tag37506	-	1	-	*Pti4 - Pti5 - Pti6*
tag28883	-	1	-	*Pti4 - Pti5 - Pti6*
tag38260	-	1	-	*Pti4 - Pti5 - Pti6*
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tag35382	-	1	-	*Pti4 - Pti5 - Pti6*
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tag42322	-	1	-	*Pti4 - Pti5 - Pti6*
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tag9035	-	2	-	*Pti4 - Pti5 - Pti6*
tag987	-	1	-	*Pti4 - Pti5 - Pti6*
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tag7739	-	1	-	*Pti4 - Pti5 - Pti6*
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tag43176	-	1	-	*Pti4 - Pti5 - Pti6*
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tag29824	-	2	-	*Pti4 - Pti5 - Pti6*
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tag40490	-	2	-	*Pti4 - Pti5 - Pti6*
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tag61772	-	-	2	*Pti4 - Pti5 - Pti6*
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tag26116	-	-	1	*Pti4 - Pti5 - Pti6*
tag86465	-	-	1	*Pti4 - Pti5 - Pti6*
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tag56018	-	-	1	*Pti4 - Pti5 - Pti6*
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tag87137	-	-	1	*Pti4 - Pti5 - Pti6*
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tag13608	-	-	2	*Pti4 - Pti5 - Pti6*
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tag81868	-	-	1	*Pti4 - Pti5 - Pti6*
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tag17690	-	-	1	*Pti4 - Pti5 - Pti6*
tag84983	-	-	1	*Pti4 - Pti5 - Pti6*
tag50199	-	-	1	*Pti4 - Pti5 - Pti6*
tag87103	-	-	1	*Pti4 - Pti5 - Pti6*
tag14004	-	-	1	*Pti4 - Pti5 - Pti6*
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tag61242	-	1	1	*Pti4 - Pti5 - Pti6 - PBS1*

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tag2842	1	-	-	*Pti5 - PBS1*
tag45093	1	-	-	*Pti5 - PBS1*
tag4166	1	-	-	*Pti5 - PBS1*
tag85136	1	-	-	*Pti5 - PBS1*
tag65821	1	-	-	*Pti5 - PBS1*
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tag55962	1	-	-	*Pti5 - PBS1*
tag7946	1	-	-	*Pti5 - PBS1*
tag48272	1	-	-	*Pti5 - PBS1*
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tag24244	-	1	-	*Pti5 - PBS1*
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tag56877	-	-	1	*Pti5 - PBS1*
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tag55588	-	-	1	*Pti5 - PBS1*
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tag98072	-	-	2	*Pti5 - PBS1*
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tag86137	-	-	1	*Pti5 - PBS1*
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tag23601	-	1	-	*Pti5 - Pti6*
tag70159	-	1	-	*Pti5 - Pti6*
tag64913	-	1	-	*Pti5 - Pti6*
tag56504	-	1	-	*Pti5 - Pti6*
tag67528	-	1	-	*Pti5 - Pti6*
tag104195	-	-	1	*Pti5 - Pti6*
tag79750	1	-	-	*Pti5 - Pti6 -Pti1*
tag28140	1	-	-	*Pti5 - Pti6 -Pti1*
tag76706	2	-	-	*Pti5 - Pti6 -Pti1*
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tag50119	1	-	-	*Pti5 - Pti6 -Pti1*
tag55095	-	1	-	*Pti5 - Pti6 -Pti1*
tag24407	-	2	-	*Pti5 - Pti6 -Pti1*
tag26087	-	1	-	*Pti5 - Pti6 -Pti1*
tag12888	-	1	-	*Pti5 - Pti6 -Pti1*
tag44388	-	-	1	*Pti5 - Pti6 -Pti1*
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tag73560	-	-	1	*Pti5 - Pti6 -Pti1*
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tag12991	1	-	-	*Pti5 - Pto*
tag11313	1	-	-	*Pti5 - Pto*
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tag71080	2	-	-	*Pti6*
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tag48587	2	-	-	*Pto - PBS1*
tag8962	1	-	-	*Pto - PBS1*
tag42186	-	1	-	*Pto - PBS1*
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tag33960	-	-	1	*Pto - PBS1*
tag27211	-	-	2	*Pto - PBS1*
tag23513	-	-	1	*Pto - PBS1*
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tag40224	1	-	-	*Pto - Pti1 -PBS1*
tag41301	-	1	-	*Pto - Pti6*
tag75308	-	-	1	*Pto - Pti6*
tag51253	2	-	-	*RAR1*
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tag84767	1	-	-	*RIN4*
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tag62272	3	-	-	*RIN4*
tag27942	-	1	-	*RIN4*
tag64684	-	1	-	*RIN4*
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tag54059	-	3	-	*RIN4*

tag384	-	-	1	*RIN4*
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tag88145	-	-	1	*RIN4*
tag34645	1	-	-	*RPP13 - PRF - RPM1 - BS2 - RX1 -GPA2*
tag92989	-	-	1	*RPP13 - PRF - RPM1 - BS2 - RX1 -GPA2*
tag61299	1	-	-	*RPS4 - Hrt*
tag33574	1	-	-	*RPS4 - Hrt*
tag53192	-	1	-	*RPS4 - Hrt*
tag29103	-	1	-	*RPS4 - Hrt*
tag94960	-	-	1	*RPS4 - Hrt*
tag43656	-	-	1	*RPS4 - Hrt*
tag76033	-	-	1	*RPS4 - Hrt*
tag27730	1	-	-	*RPS4 - Xa1 -I2 -RP1*
tag13076	1	-	-	*RPS4 - Xa1 -I2 -RP1*
tag11918	1	-	-	*RPS4 - Xa1 -I2 -RP1*
tag71272	1	-	-	*RRS1*
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tag87160	1	-	-	*RRS1*
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tag56807	1	-	-	*RRS1*
tag65770	2	-	-	*RRS1*
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tag59411	2	-	-	*RRS1*
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tag27154	1	-	-	*RRS1*
tag6794	1	-	-	*RRS1*
tag15148	2	-	-	*RRS1*
tag15020	1	-	-	*RRS1*
tag25235	1	-	-	*RRS1*
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tag16251	-	1	-	*RRS1*
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tag39538	-	2	-	*RRS1*
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tag48700	-	1	-	*RRS1*
tag21600	-	1	-	*RRS1*
tag66617	-	1	-	*RRS1*
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tag9603	-	-	1	*RRS1*
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tag57830	-	-	1	*RRS1*
tag13411	-	-	1	*RRS1*
tag48703	-	-	3	*RRS1*

tag29290	-	-	1	*RRS1*
tag38375	1	-	-	*RRS1 - N*
tag71343	1	-	-	*RRS1 - WRKY25*
tag19772	-	1	-	*RRS1 - WRKY25*
tag79577	1	-	1	*RRS1 - WRKY25 -WRKY33*
tag42863	1	-	-	*RRS1 - WRKY25 -WRKY33*
tag47776	1	-	-	*RRS1 - WRKY25 -WRKY33*
tag58707	-	1	-	*RRS1 - WRKY25 -WRKY33*
tag38531	-	1	-	*RRS1 - WRKY25 -WRKY33*
tag37227	-	1	-	*RRS1 - WRKY25 -WRKY33*
tag66981	-	1	-	*RRS1 - WRKY25 -WRKY33*
tag99363	-	-	1	*RRS1 - WRKY25 -WRKY33*
tag82448	-	-	1	*RRS1 - WRKY25 -WRKY33*
tag85785	-	-	1	*RRS1 - WRKY25 -WRKY33*
tag31832	1	-	-	*RX1 - RPP8*
tag42036	1	-	1	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag29626	1	-	-	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag9926	1	-	-	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag9058	1	-	-	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag25692	-	1	-	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag7971	-	1	-	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag59552	-	-	1	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag20760	-	-	1	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag6419	-	-	1	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag57530	-	-	1	*RX1 - RPP8 - GPA2 -RPS5-RPM4*
tag25741	1	-	-	*WRKY25 - WRKY29 - WRKY33*
tag63886	1	-	-	*WRKY25 - WRKY29 - WRKY33*
tag59019	1	-	-	*WRKY25 - WRKY29 - WRKY33*
tag55445	-	1	-	*WRKY25 - WRKY29 - WRKY33*
tag51212	-	1	-	*WRKY25 - WRKY29 - WRKY33*
tag20743	1	-	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag83980	2	-	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag22154	1	-	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag64011	1	-	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag57928	1	-	-	*WRKY25 - WRKY29 - WRKY33 - RRS1*
tag18109	-	1	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag55254	-	1	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag19317	-	1	-	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag50281	-	1	-	*WRKY25 - WRKY29 - WRKY33 - RRS1*
tag43611	-	1	-	*WRKY25 - WRKY29 - WRKY33 - RRS1*
tag14518	-	-	1	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag64923	-	-	1	*WRKY25 - WRKY29 - WRKY33 -RRS1*
tag75266	1	-	-	*WRKY25 - WRKY33*
tag70098	1	-	-	*WRKY25 - WRKY33*

tag35648	1	-	-	*WRKY25 - WRKY33*
tag26852	1	-	-	*WRKY25 - WRKY33*
tag65424	-	1	-	*WRKY25 - WRKY33*
tag11468	1	-	-	*WRKY25 - WRKY33 - RRS1*
tag69699	2	-	-	*WRKY25 - WRKY33 - RRS1*
tag45416	1	-	-	*WRKY25 - WRKY33 - RRS1*
tag10694	1	-	-	*WRKY25 - WRKY33 - RRS1*
tag21300	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag5126	1	-	-	*WRKY25 - WRKY33 - RRS1*
tag41632	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag63593	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag47928	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag39309	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag17329	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag1697	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag26035	1	-	-	*WRKY25 - WRKY33 -RRS1*
tag60039	-	2	-	*WRKY25 - WRKY33 - RRS1*
tag70862	-	1	-	*WRKY25 - WRKY33 - RRS1*
tag67186	-	1	-	*WRKY25 - WRKY33 - RRS1*
tag47133	-	1	-	*WRKY25 - WRKY33 - RRS1*
tag4522	-	1	-	*WRKY25 - WRKY33 -RRS1*
tag36159	-	1	-	*WRKY25 - WRKY33 -RRS1*
tag45592	-	1	-	*WRKY25 - WRKY33 -RRS1*
tag41604	-	1	-	*WRKY25 - WRKY33 -RRS1*
tag34132	-	1	-	*WRKY25 - WRKY33 -RRS1*
tag15114	-	1	-	*WRKY25 - WRKY33 -RRS1*
tag22617	-	1	-	*WRKY25 - WRKY33 -RRS1*
tag42860	-	-	1	*WRKY25 - WRKY33 - RRS1*
tag27517	-	-	1	*WRKY25 - WRKY33 - RRS1*
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tag83199	-	-	1	*WRKY25 - WRKY33 - RRS1*
tag3646	-	-	1	*WRKY25 - WRKY33 -RRS1*
tag46995	-	-	1	*WRKY25 - WRKY33 -RRS1*
tag29090	-	-	1	*WRKY25 - WRKY33 -RRS1*
tag85913	-	-	1	*WRKY25 - WRKY33 -RRS1*
tag80007	-	-	2	*WRKY25 - WRKY33 -RRS1*
tag64564	-	-	1	*WRKY25 - WRKY33 -RRS1*
tag1237	-	-	1	*WRKY25 - WRKY33 -RRS1*
tag70732	-	-	1	*WRKY25 - WRKY33 -RRS1*
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tag45873	-	-	1	*WRKY25 - WRKY33 -RRS1*
tag37370	-	1	-	*WRKY33*
tag85459	1	-	-	*WRKY33 - WRKY25 - WRKY29*
tag32246	1	-	-	*WRKY33 - WRKY25 - WRKY29*
tag81717	1	-	-	*WRKY33 - WRKY25 - WRKY29*
tag75119	-	-	1	*WRKY33 - WRKY25 - WRKY29*
tag66871	1	-	-	*WRKY33 - WRKY25 - WRKY29 - RRS1*
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tag32590	1	-	-	*WRKY33 - WRKY25 - WRKY29 - RRS1*
tag86532	1	-	-	*WRKY33 - WRKY25 - WRKY29 - RRS1*
tag58034	-	1	-	*WRKY33 - WRKY25 - WRKY29 - RRS1*
tag28270	-	1	-	*WRKY33 - WRKY25 - WRKY29 - RRS1*
tag46761	-	-	1	*WRKY33 - WRKY25 - WRKY29 - RRS1*
tag22826	-	-	1	*WRKY33 - WRKY25 - WRKY29 - RRS1*
tag50494	1	-	-	*Xa1*
tag33650	1	-	-	*Xa1*
tag13435	1	-	-	*Xa1*
tag29167	-	1	-	*Xa1*
tag2916	-	-	1	*Xa1*
tag42672	-	1	-	*Xa1 - I2 - RP1*
tag86739	-	-	1	*Xa1 - I2 - RP1*