

Expression Atlas: exploring plant gene expression results

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This practical will introduce you to the data content and functionality of Expression Atlas (www.ebi.ac.uk/gxa/home) at EMBL-EBI.

More information can be found on:

- Expression Atlas: Quick tour: <https://www.ebi.ac.uk/training/online/course/expression-atlas-quick-tour-1>
- Expression Atlas help page: <https://www.ebi.ac.uk/gxa/help/index.html>
- Expression Atlas FAQ section: <https://www.ebi.ac.uk/gxa/FAQ.html>



Exercise 2

Differential Expression – Find differentially expressed genes in response to powdery mildew in wheat

Scenario

Powdery mildew disease caused by *Blumeria graminis* f. sp. *tritici* (Bgt) inflicts severe economic losses in wheat crops. You are working on a research project to better understand the molecular mechanisms involved in wheat resistance to Bgt. In order to start exploring that field, you decide to check if there are any dataset in Expression Atlas related to the response to powdery mildew in wheat.

Tasks – Differential expression results

Use the **Biological conditions search box** on Expression Atlas home page to search for *Blumeria graminis*. Start typing the first characters of “*Blumeria*” and you will see a list of suggestions.

Only the **Differential expression results** component of Expression Atlas will be active. You will see a table with a maximum of 1,000 genes differentially expressed (DE) in each of the comparisons that involve *Blumeria graminis*.

1. From how many species do we have datasets involving *Blumeria graminis*?
Hint: You can filter the results by using the filters on the left. For example, you might want to select datasets from *Triticum urartu* or from *Triticum aestivum*.

2. Let's focus on *Triticum aestivum* datasets. Can you find what is the plant tissue that has been used in the first comparison 'Blumeria graminis; 24 hour' vs 'control'? What samples are considered as "reference" or control group?

Hint: When you mouse over the title of each comparison you will see more details about each of the two groups of plant samples compared.

Tasks – Differential experiment page

Let's have a look now at the experiment "*Transcription profiling by high throughput sequencing of the hexaploid wheat line N9134 inoculated with Stripe rust and powdery mildew*"

3. How many comparisons does this experiment involve?
4. How many samples were sequenced for each group? Were all plants sequenced at the same developmental stage?

Hint: Explore the **Experimental Design** tab

5. In terms of number of DE genes, does the infection with *Blumeria graminis* (Bgt) have the same effect that the response to *Puccinia striiformis* (Pst)?

Hint: Explore the **Results** tab. How many genes are DE in each comparison? You can select each of the comparisons from the Select button in the left.

6. What is the criterion for considering a gene as differentially expressed?
7. In the comparison 'Blumeria graminis; 24 hour' vs 'control', how many genes are DE with a more stringent criteria of absolute value of log2-fold change > 2 and adjusted p-value < 0.01?

8. Are there any processes enriched in the list of DE genes? Or more specifically, is there any Gene Ontology, InterPro or Reactome term statistically over-represented in the set of genes that are DE?

Hint: Explore the **Plots** tab.

9. Let's explore the results related to Reactome pathways enrichment analysis. Is there any Reactome pathway enriched in response to *Blumeria graminis*?

10. How many genes annotated as "IAA Biosynthesis I" (R-TAE-1119486) are differentially expressed in response to *Blumeria graminis*? How many of them are up-regulated? And down-regulated?

Hint: Explore the **Results** tab

11. Let's have a look now at the Reactome pathways enriched in response to *Puccinia striiformis*. You will see that the Reactome pathway "Circadian rhythm" (R-TAE-8933811) is enriched in the three comparisons involving *Puccinia striiformis*. How many genes annotated as "Circadian rhythm" (R-TAE-8933811) are differentially expressed in response to *Puccinia striiformis*? How many of them are up-regulated? And down-regulated?