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Biol 862 Plant-Animal interactions
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Annotated Bibliography

Plant defense to Nematode infection

J. P. Sheridan, A. J. Miller and R. N. Perry (2004). Early responses of resistant and susceptible potato roots during invasion by the potato cyst nematode Globodera rostochiensis. *Journal of Experimental Botany*, 55, (397) 751-760.

This article explains the physiological response of the specific potato species upon infection by the specific nematode species. This article is interesting enough to initiate the research on specific stimulus and response, however it fails to do so due to the luck of controls. For example, first, two species of plant roots are measured by their voltage change upon nematode infection. The author attempts to identify if this physiological response comes from physical stimulus or chemical stimulus. Both cases of stimulus don't show similarity to initial response. The authors claim that it is because the plans might have developed a defense mechanism. However, they fail to show any evidence that the initial and secondary physiological response are specific to Nematode species.

Poch, H. L. C., Lopez, R. H. M., & Kanyuka, K. (2006) Functionality of resistance gene *Hero*, which controls plant root-infecting potato cyst nematodes, in leaves of tomato. *Plant, Cell and Environment* 29, 1372–1378.

This article shows the non-tissue specific gene expression upon infection. Apoptosis is the common plant defense upon infection. This article explains the infection induction of resistant gene expression. Non-organ specific nematode infection Resistance (R) gene, Hero is normally expressed in the root of a tomato species. In this article, they show this gene is not root specific, but also can be expressed in leaves therefore preventing gall formation. PCN species *G. rostochiensis* and *Globodera pallida* can grow on this Hero Tomatoes on leaves. As a result hypersensitive reaction (HR), programmed cell death is ectopically expressed and not restricted to the tissues of the infection site. This article has no significant impression.

Nematode infection mechanism

Prior, A., Jones, J. T., Blok, V. C., Beauchamp, J., McDermott, L., Cooper A., and Kennedy, M. W. (2001). A surface-associated retinol- and fatty acid-binding protein (Gp-FAR-1) from the potato cyst nematode Globodera pallida : lipid binding activities, structural analysis and expression pattern. *Biochem. J.* 356, 387-394.

Agricultural damage results in large economical damage. For instance, potatoes are damaged by sedentary endoparasitic nematodes such as the root knot nematodes

(*Meloidogyne* spp.) and the cyst nematodes including the potato cyst nematodes *Globodera rostochiensis* and *Globodera pallida*. These nematodes use secreted proteins which have been implicated in many aspects of the host-parasite interaction. The secreted protein works as an enzyme to break down cellwalls. Therefore leading to the successful migration of nematodes to the feeding site. Nematodes also secrete enzymatic proteins to maintain the syncytium. Among the unknown genes in the nematode genome, they investigated fatty-acid- andretinol-binding (FAR) proteins. The properties of Gp-FAR-1 from the plant-parasitic nematode *G. pallida* are still unstudied compare to animal parasitic species. The author demonstrates that this retinol-and fatty-acid-binding protein interfere with host defense mechanism and has biochemical properties to inhibit the mechanism. This article is interesting for the detailed work though, it lacks impact to introduce in the class.

<u>Nematode and bacteria on same plants</u>

Chau, S., Chu, Y., and Houang. E. T. S. (2004). Novel Resistance-Nodulation-Cell Division Efflux System AdeDE in *Acinetobacter* Genomic DNA Group 3 Antimicrobial Agents and Chemotherapy, 48, (10) 4054–4055.

The expressions of nodulation genes are well-controlled process and possibly interact with bacterial nodulation. The authors performed PCR on the Resistance-nodulation-cell division (RND) type efflux pumps genes and fragment of AdeABC genes shown to contribute to multidrug resistance in *Acinetobacter baumannii*. It is interesting idea that they stated the interaction of between Bacteria and nematode, rather than host and parasite.

Krechel, A., Faupel, A., Hallmann, J., Ulrich, A., and Berg, G., (2002). Potato-associated bacteria and their antagonistic potential towards plant-pathognic fungi and the plnat-parasitic nematode *Meloidogyne incognita* (Kofoid & White) Chitwood. *Can. J. Microbiol*. 48, 772-786.

Bacteria don't just exchange a nutritious benefit with the bacteria, but also protect them from fungi and nematode. This article first investigated what populations of bacteria live on the same plant by performing BOX-PCR on 16S rDNA. Based on the enzymatic activity those bacteria sustain, the authors determined the defense effect on plants from fungal or nematode infection. It is an interesting idea that bacteria also help plant by providing mechanism that prevents invasions from other pathological or parasitic.

<u>Nematode and plant gene expression for Nodulation</u>

Favery, B., Complainville, A., Vinardell, J. M., Lecomte, P., Vaubert, D., Mergaert, P., Kondorosi, A., Kondorosi, E., Crespi, M., and Abad, P., (2002). The Endosymbiosis-Induced Genes *ENOD40* and *CCS52a* Are Involved in

Endoparasitic-Nematode Interactions in *Medicago truncatula. MPMI* 15, (10) 1008–1013

This article reports overlapping gene regulation between mutualism and parasitic interaction of plants, *Sinorhizobium meliloti,* and nematodes. They investigate if the symbiont and the biotrophic interaction can be regulated by similar pathways in a plant, *Medicago truncatula*. First, in both cases, *Sinorhizobium* and nematode forms special feeding sites, nodules and galls respectively. Those sites are swollen upon inoculation or infection and provide housing for them. Taking into account that nitrogen fixing root nodules requir the activation of specific genes in the host plant, the researcher compares and contrasts the expression patterns of nodule-expressed genes after infection with the root-knot nematode, *Meloidogyne incognita*. In the galls formed by the nematode, two regulators during nodule organogenesis were induced. *ENOD40* is involved in primordium formation, and the cell cycle gene *CCS52a* required for cell differentiation and endoreduplication**.** Those genes are timely expressed in the plants and have specific localization. They also ectopically expressed *ENOD40* and show this gene itself is sufficient to form galls. They further study gene expression profiles in galls and in nodules using macroarray analysis. Among 192 nodule-expressed genes, 38 genes are upregulated in nodule and only two genes, nodulin 26 and cyclin D3 in galls. These results suggest that both Sinorhizobium and nematodes share some mechanisms for endoreduplication, cell-to-cell communication with vascular tissues, or water transport.

P. Hutangura, U. Mathesius, M. G. K. Jones and B. G. Rolfe (1999). Auxin induction is atrigger for root gall formation caused by root-knot nematodes in white clover and is associated with the ctivation of the flavonid pathway. ***Aust. J. Plant Physiol.,*** **26 221-231.**

Auxin! That is fascinating. The nematode nodule formation is regulated by the plant growth hormone. The authors use reporter assay in plants with genes which is downstream expressed by an infection signal from nematodes. The authors find that the infection signal induces timely expression of auxin and its localization at the site of the infection.

Yan, Y., Smant, G., Stokkermans, J, Qin, L., Helder, J., Baum, T., Schots, A., Davis, E., (1998). Genomic organization of four b-1,4-endoglucanase genes in plant parasitic cyst nematodes and its evolutionary implications. ***Gene,*** **61-70**

The expression of the plant gene is modified by nematode infection. The infecting parasite also encodes genes specifically used for the plant infection. The example of such genes are b-1,4-endoglucanases (cellulases) from the plant-parasitic cyst nematodes *Heterodera glycines* and *Globodera rostochiensis* (HG-*eng1*, Hg-*eng2*, GR-*eng1*, and GR-*eng2*). First they looked at the genetic components such as introns and structural domains. HG-*eng1* and HG-*eng2* introns didn't show any similarity. However, GR-*eng1* and GR-*eng2* were almost identical. The conserved domains of GR-eng2 which are splice sites and cleavage signal sequences are both rare occurrences in eukaryotic genes. They also find similarity with the eukartotic genome such as TATA boxs, bHLH-type binding sites, and putative silencer, repressor, and enhancer elements. Phylogenic analysis shows a in high conservation of cellulase family genes with bacterial species. As in the discussion, they argue that those genes involved in infection events are horizontally transferred species to species. I think they need to show functional similarity of those proteins not only in sequence conservation but by showing these genes are orthologous to each other.

Plant & Nitrigen Fixation Bacteria

AgBiotech Infosource, (1999) Rhizobium and Nitrogen Fixation, *Ag-West Bioech INC.* 50.

This article reviews symbiotic Nitrogen fixation bacteria and plant interactions. The nitrogen source for agricultural plants and symbiotic nitrogen fixation are first explained. Although this paper is not published in a science journal, it gives enough detail of the nitrogen fixation system that benefits bacteria and plant exchange. For example, they explain that bacteria species can change bonding or state of Nitrogen, and its proximity to the plant species. This article refers gene expression conducts symbiotic events upon nodule induction. The flavonoid signal guidance of root growth toward bacterial species, and finally the orchestral nodulin gene expression for nodule formation are explained.

Other Nematode papers

P. Dı´az, A. Paz-Silva, R. Sa´nchez-Andrade, J.L. Suarez, J. Pedreira, M. Arias, P. Dı´ez-Ban˜os, P. Morrondo (2007). Assessment of climatic and orographic conditions on the infection by Calicophoron daubneyi and Dicrocoelium dendriticum in grazing beef cattle (NW Spain). *Veterinary Parasitology* 149 (2007) 285–289

In a recent study, Dicrocoeliosis which is caused by flukes, Dicrocoelium spp. has been increased in grass grazing beef cattle. Ants and snails transmit flukes to the cattle. In the feeding process, plants are used to present fluke infected ants. Due to the agricultural effect, the site of feeding is over populated by cows, and cattle are forced to eat grass with fluke infected ants. In this article, the authors describe the effect of climate on trematode species infection, especially in NW Spain. In contrast to historical belief, that dry and hot climates are suitable for them, they reported that the trematodes successfully continue their life cycle in humid areas. Finally, they suggest atmospheric and orographic conditions for the development of the life cycle of trematodes, Calicophoron daubneyi and Dicrocoelium dendriticum. Although this species of parasite doesn't infect plants, they use the structure of plant to feed on animal species for their next life cycles.

Jog, M., and Watve, M. (2005). Role of parasites and commensals in shaping host behaviour. ***CURRENT SCIENCE*****, 89 (7, 10) 1184-1191**

For successful parasites, the adaptation with their hosts is necessary. This article gives an overview of the parasite-induced and parasite-selected host behaviors. Their focus is on the ecological and evolutionary consequences for the host and the parasite. And also, their life cycles that are associated with these consequences. This article starts with host behavior to avoid infection from parasite. Ie) scraping and head shaking etc. are the way of getting rid of parasites from their bodies. This is an interesting point of view. They clam these common behavior is evolutionally selected behavior for hosts who closely live with the parasitic species. Then of cause this article explain these host behavior changes. Another point of view they explained and was interesting to me is the non-specificity of nematode infection: the long history of parasitic nematode often choose non-specific host. They explain that specificity and disease associated with specific species cause less chance of success in survival. This guy really points out many interesting points. I would like to read more of Watve's paper!!!