Expressed genes and control, what new sequencing technologies can do for pest management.

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Summary

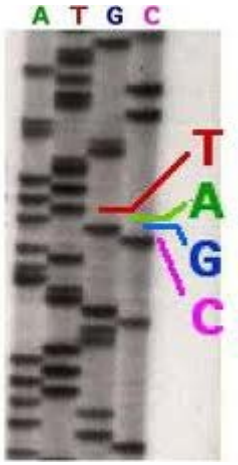
- Available technologies
  - Laboratory
  - Computacional
- Use in agriculture
- Possible benefits for pest management
  - Some avenues being explored
- What do we have in tobacco?
- What do we plan to do.

"Insect pest control will soon enter the genomic era with all its surprises and discoveries, as pest and parasitoids genomes are now available."

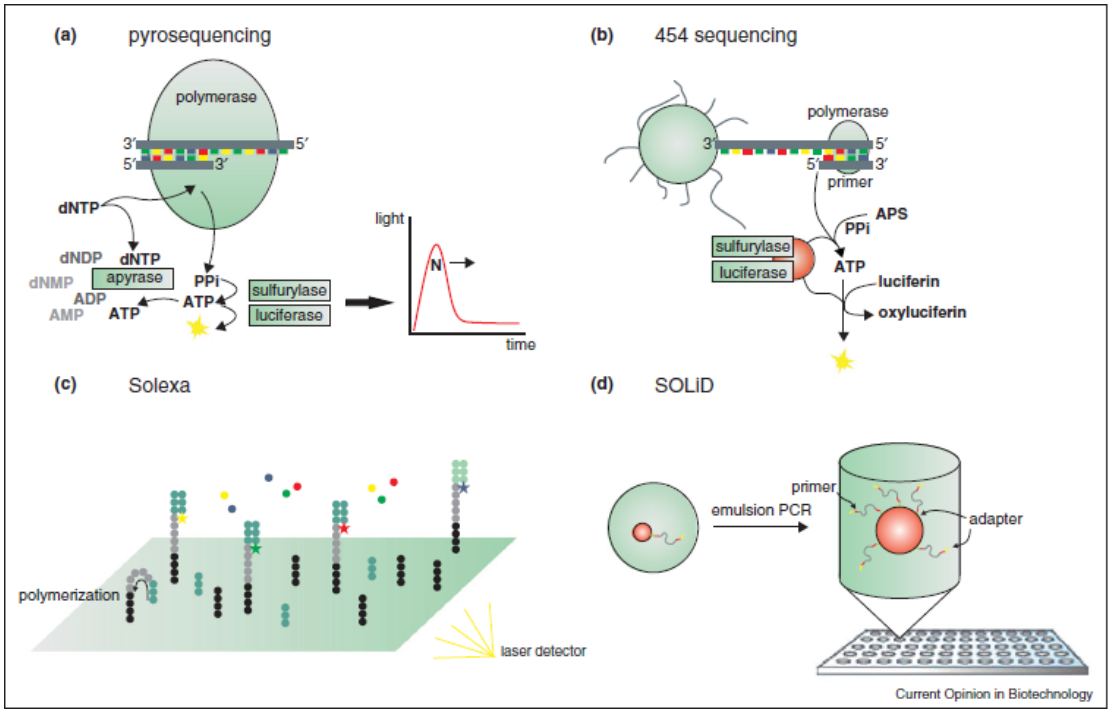
Chilana *et al.* 2012. Current Science 104, 4.

Available technologies

DNA sequencing technologies keep evolving



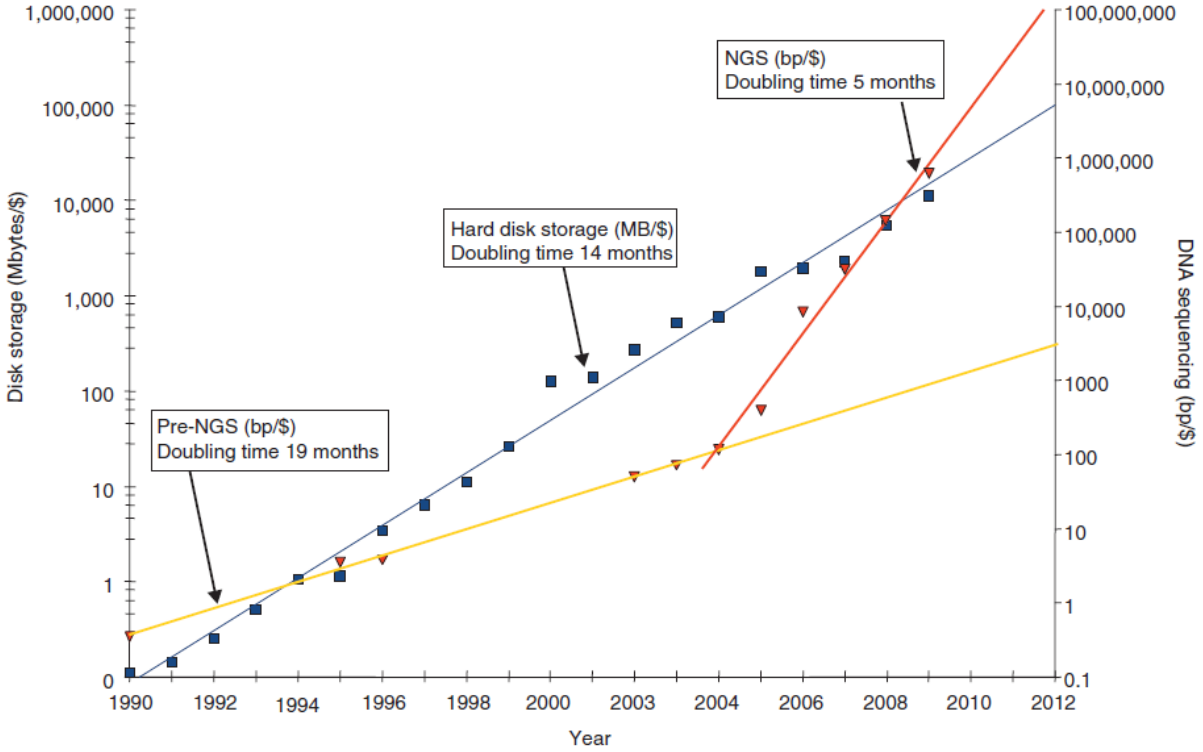
Sanger sequencing



Mutz *et al.* 2013. Current Opinions in Biotechnology 24

Available technologies

And the cost per sequence is getting cheaper



Stein 2010, Genome Biology 11

Available technologies

And now even a “small” project can be considered “big data”

http://hawaiigreenit.com/cloudcomputing.html

Use in Agriculture

- Genomes from cultivated plants tend to be "complicated".
- Rice sequenced in 2002
- 38 crops sequenced (Michael & Jackson 2013)

Use in Agriculture

- ~ 85 insect genomes, mostly Drosophila and disease vectors.
- Notables:
  - Med Fly
  - Diamondback Moth
  - Colorado Potato B.
- More coming in the near future

Possible benefits for pest management

- Species identification

Development of a DNA microarray for species identification of quarantine aphids

Won Sun Lee,[a†] Hwalran Choi,[b†] JinSeok Kang,[a] Ji-Hoon Kim,[a] Si Hyeock Lee,[b] Seunghwan Lee[b*] and Seung Yong Hwang[a*]

Rapid molecular diagnosis of the stored-product psocid *Liposcelis corrodens* (Psocodea: Liposcelididae): Species-specific PCR primers of 16S rDNA and COI

Qianqian Yang [a], Shuo Zhao [a,e], Zuzana Kučerová [b], George Opit [c], Yang Cao [d], Václav Stejskal [b], Zhihong Li [a,*]

Possible benefits for pest management

- Microbiome identification

DNA Sequencing Reveals the Midgut Microbiota of Diamondback Moth, *Plutella xylostella* (L.) and a Possible Relationship with Insecticide Resistance

Xiaofeng Xia[1,2,3], Dandan Zheng[1,2], Huanzi Zhong[4], Bingcai Qin[4], Geoff M. Gurr[1,5], Liette Vasseur[1,6], Hailan Lin[1,2], Jianlin Bai[1,2], Weiyi He[1,2], Minsheng You[1,2]*

Identification And Location Of Symbionts Associated With Potato Psyllid (*Bactericera cockerelli*) Lifestages

DAYMON HAIL,[1,2] SCOT E. DOWD,[3] AND BLAKE BEXTINE[1]

Possible benefits for pest management

- And of course, transcriptomes

Development of Reference Transcriptomes for the Major Field Insect Pests of Cowpea: A Toolbox for Insect Pest Management Approaches in West Africa

Tolulope A. Agunbiade[1*], Weilin Sun[1], Brad S. Coates[2], Rousseau Djouaka[3], Manuele Tamò[3], Malick N. Ba[4], Clementine Binso-Dabire[4], Ibrahim Baoua[5], Brett P. Olds[6], Barry R. Pittendrigh[1]

Transcriptome Analysis and Screening for Potential Target Genes for RNAi-Mediated Pest Control of the Beet Armyworm, *Spodoptera exigua*

Hang Li[1,2☯], Weihua Jiang[1,2☯], Zan Zhang[1,2], Yanru Xing[1,2], Fei Li[1,2*]

1 Department of Entomology, College of Plant Protection, Nanjing Agricultural University, Nanjing, China, 2 Key Laboratory of Integrated Management of Crop Diseases and Pests, Ministry of Education, Nanjing Agricultural University, Nanjing, China

Possible benefits for pest management

- Transcriptomes identify expressed genes.
- Useful for applied studies.
- Genetic responses to pesticides, plant chemicals, other control measures.
- New genetic markers, possible targets, new control approaches.
- Next step, correlate transcriptome with "metabolome" and biochemistry. Combined insect-plant response.

What do we have in tobacco?

- *N. sylvestris* and *N. tomentosiformis* genomes
- Partially completed *N. tabacum* genome.
- *Manduca sexta* genomes and *Myzus persicae* partially completed.

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What don't we have in tobacco?

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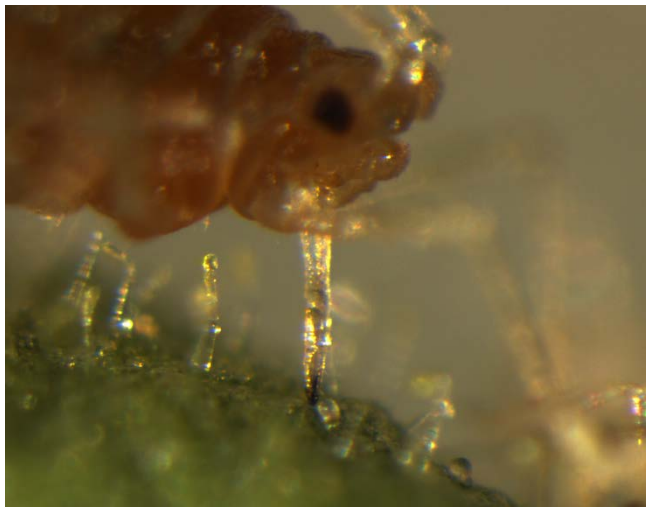
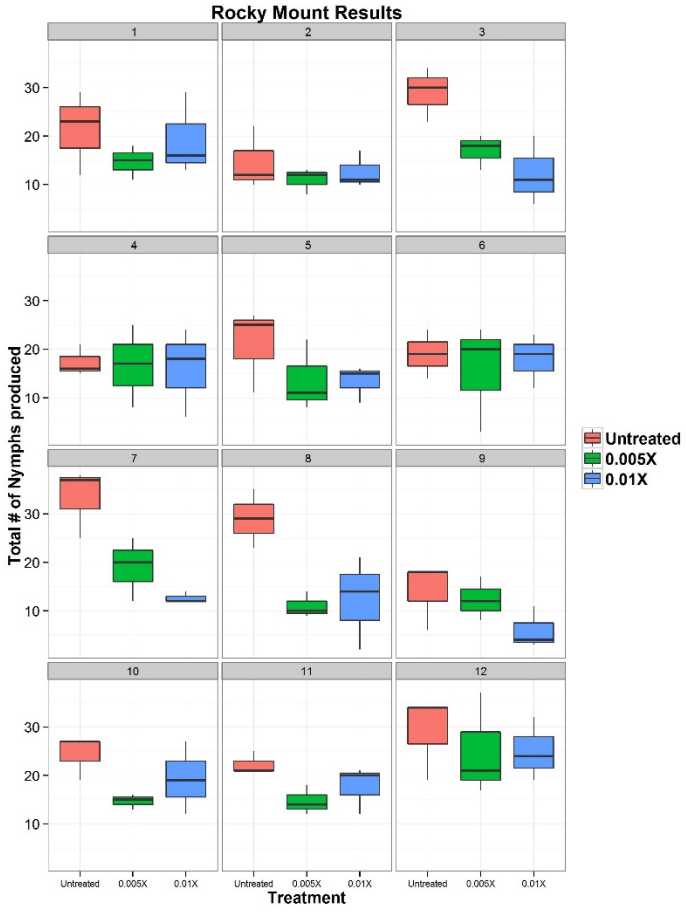
- Not all pests are covered.
- A centralized database.
- An organized effort as an industry to develop these tools.

What do we plan to do

- What is the genetic response to imidacloprid in *Myzus persicae?*
- How does it correlate with the response to nicotine?

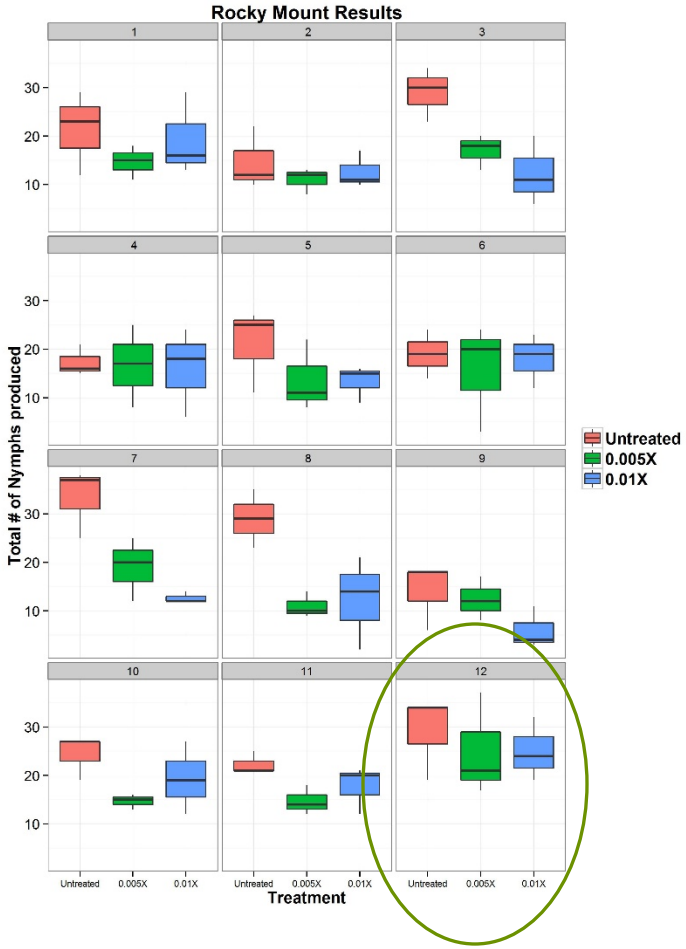


What do we plan to do



- Collected 12 "clones" in 4 research stations.
- Exposed them to 3 leaves treated with 3 pesticides levels and measured fecundity.

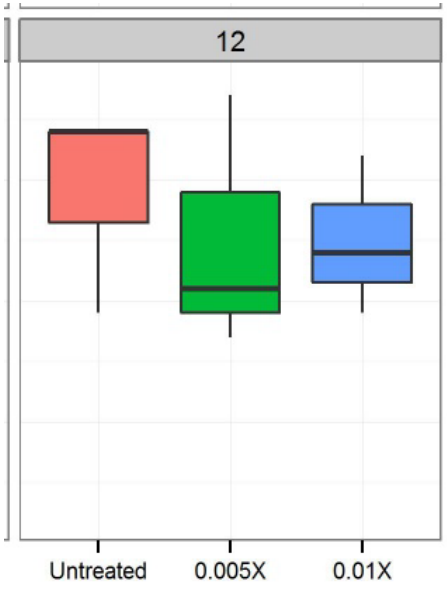
What I plan to do



- Collected 12 "clones" in 4 research stations.
- Exposed them to 3 leaves treated with 3 pesticides levels and measured fecundity.

What I plan to do

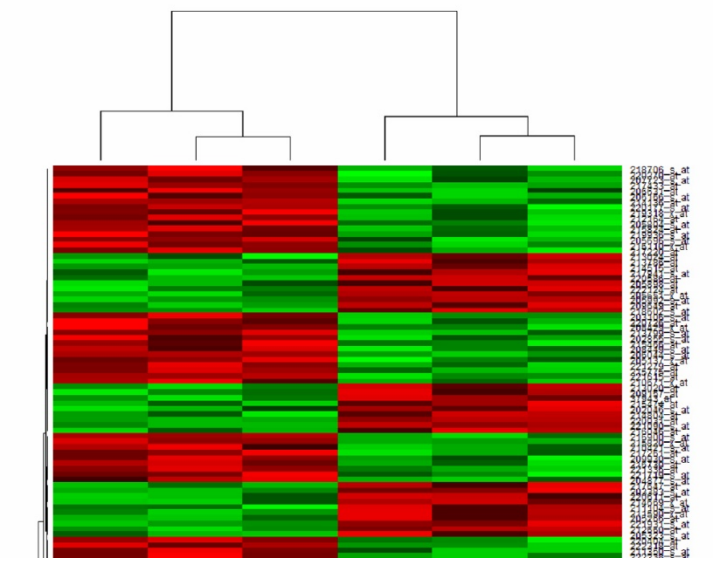
- 5 “clones” per research station are maintained in pesticide treated leaves.



Rocky Mount 12 at 0.005X

What do we plan to do

- Expose “resistant” clones to imidacloprid and nicotine and measure changes in gene expression.



http://accelrys.com/products/pipeline-pilot/component-collections/gene-expression.html

What do we plan to do

Expected outcomes

- A better understanding about the genetic mechanisms involved in metabolic resistance.
- Comparison between pathways involved in pesticide and alkaloid resistance.
- New possible target that might help manage insecticide resistance and increase the life of neonicotinoids.

Take home messages

- Genomics is an important tool for pest management and has the potential to affect different aspects about control strategies.
- Strong computing skills are becoming a requirement for students and researchers involved in genomics.
- Transcriptomes have the potential to produced useful data for applied science.

Take home messages

- Do we need to centralize the genomic resources that relate to the tobacco industry?
- Does the industry need to fund more genomic research?
- Understanding resistance mechanisms through genomics can help us improve chemical control, host plant resistance and develop new control strategies (GMO's).

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Questions?