Tobacco Alkaloid Genetics (TAG) 2017 Report

Coordinator: Liuying Wen, TRI-CAAS, China
Presenter: Yongfeng Guo, TRI-CAAS, China

Santa Cruz do Sul, Brazil

23 October 2017

Objectives

1. **To understand the genetics that control alkaloid formation in tobacco plants.**
2. **To understand the feasibility of conventional and non-conventional breeding techniques to modify alkaloid formation in tobacco plants.**
3. **To understand the impact of tobacco alkaloid levels on leaf production and quality.**

Timeline

- **Before 2017 CORESTA AP meeting**
  - To complete the collection of various kinds of publicly available literature and data related to tobacco alkaloids.
  - To cluster the alkaloid related factors into different categories including tobacco alkaloid biosynthesis genes, transporters, and regulators.
  - To list the known mechanisms of tobacco alkaloid genetic control.
- **Before 2018 CORESTA Congress**
  - To complete the collection of various kinds of publicly available literature related to tobacco breeding technology.
  - To identify conventional and non-conventional technologies used in tobacco breeding to modify alkaloid levels.
  - To make a summary of techniques used in modification of tobacco alkaloids.
- **Before 2019 CORESTA AP meeting**
  - To complete the collection of various kinds of publicly available literature related to the evaluation of tobacco quality and production from tobacco plant containing different alkaloid levels.
  - To draft a final report of the TAG TF.

Status

- **Work had finished**
  - **Collected available literature and data related to tobacco alkaloids**
  - **Alkaloid biosynthesis**
  - **Alkaloid transporters**
  - **Alkaloid regulation**

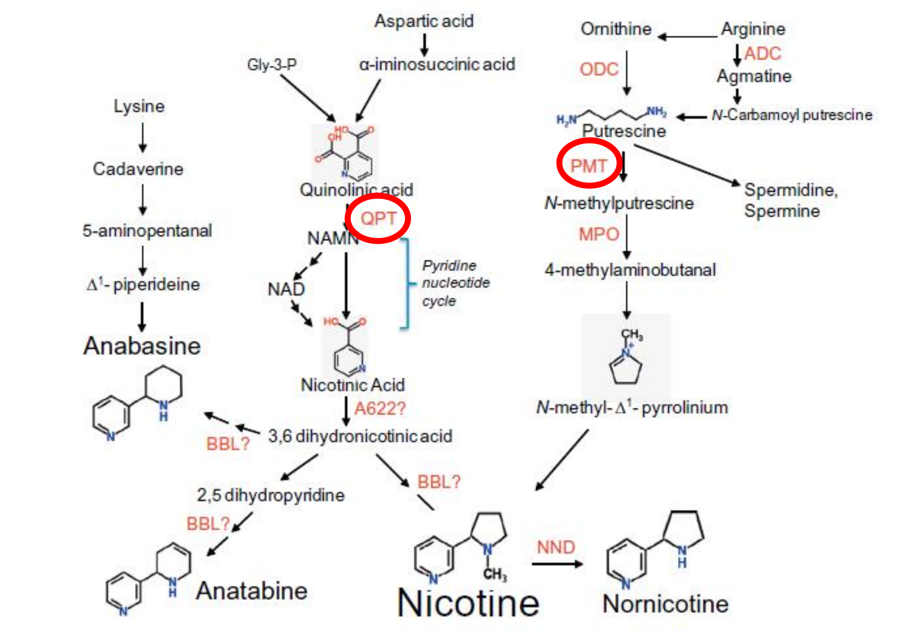
Alkaloid in tobacco

- Commercial tobacco cultivars: Alkaloid 2%-4% of total dry weight
  - Nicotine ----------- 90% of the total alkaloid content
  - Nornicotine
  - Anatabine
  - Anabasine

  (Nornicotine, Anatabine, Anabasine) Nearly 10%

Alkaloid biosynthesis genes

- Key rate-limiting enzyme
- PMT: putrescine methyltransferase;
- QPT: quinolinate phosphoribosyltransferase.
- ODC: ornithine decarboxylase;
- ADC: arginine decarboxylase;
- MPO: N-methylputrescine oxidase;
- BBL: berberine bridge enzyme-like;
- A622: isoflavone reductase-like protein;
- NND: nicotine N-demethylase;



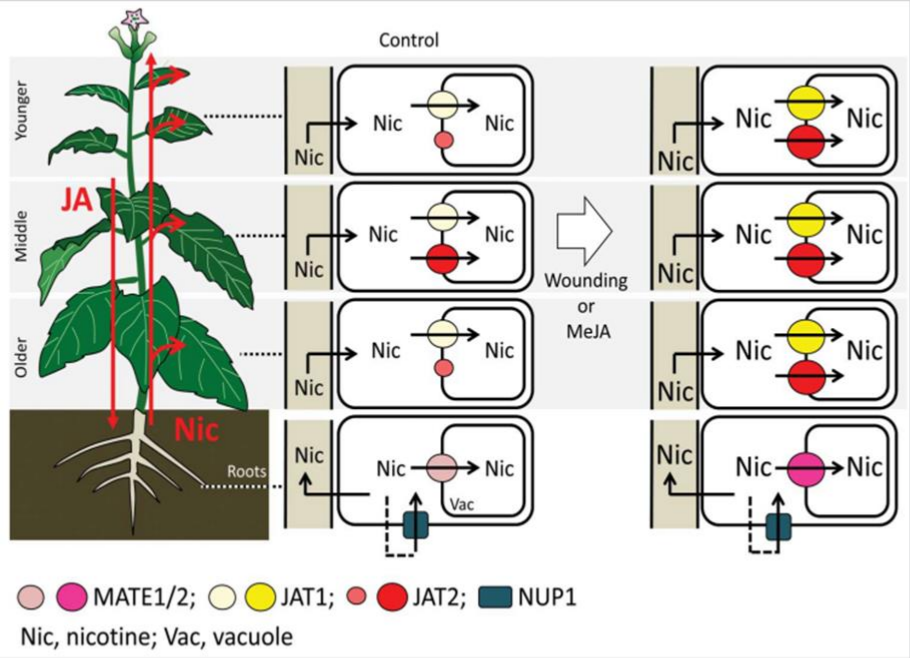
Dewey and Xie (2013)

Fig. 1. Schematic diagram of alkaloid biosynthesis in *N. tabacum*.

Alkaloid transporters

- **Root tip: NUP1**
- **Root: JAT1,MATE1/2**
- **Leave: JAT2**

- MATE1/2：Multidrug and toxic compound extrusion 1/2
- JAT1/2：Jasmonate-inducible alkaloid transporter 1/2
- NUP1：Nicotine uptake permease1

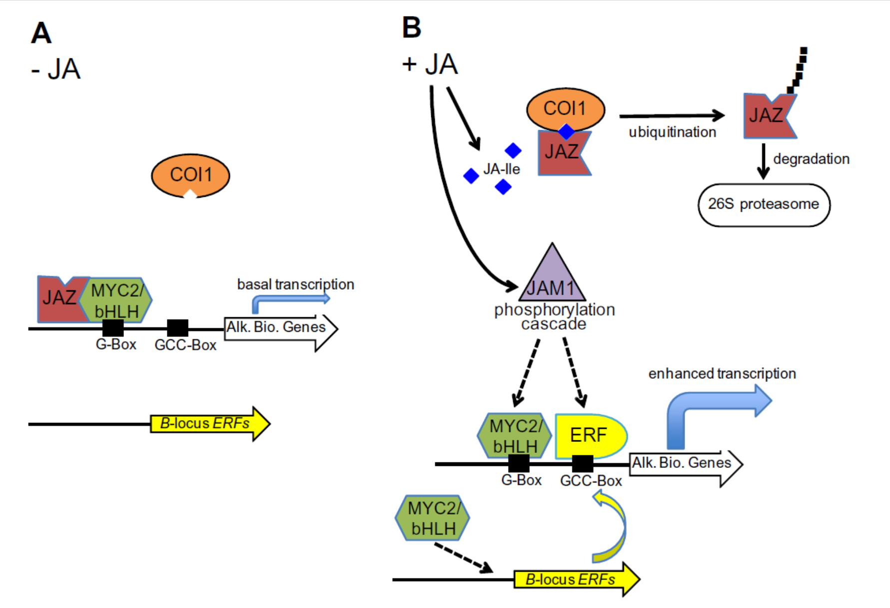


Shitan.et al. (2015)

Fig. 2. Hypothetical model of nicotine transporter functions in *N. tabacum*.

Alkaloid Regulators

- **ERF:189, 221**
- **MYC2/bHLH**
- **COI1,JAZ**
- **JAM1**

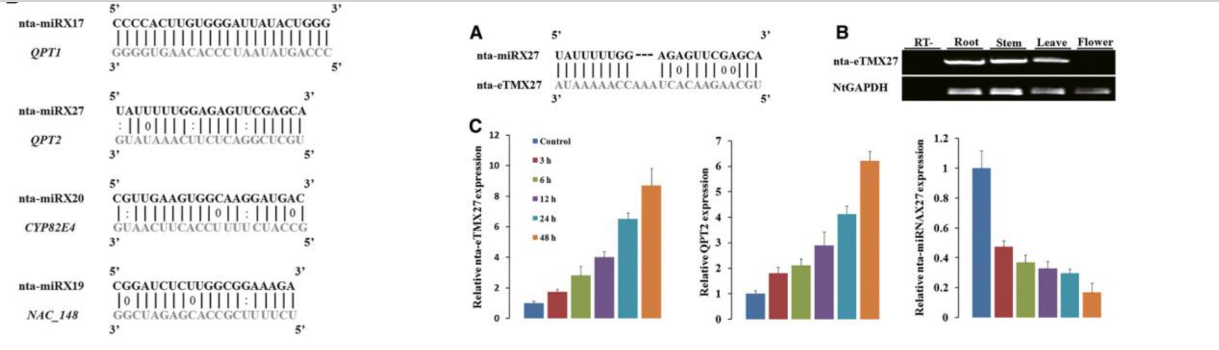


Dewey and Xie (2013)

Fig. 3. Model depicting our current understanding of JA-stimulated induction of alkaloid biosynthetic genes in tobacco

Transcriptional regulation of Alkaloid

- **Nicotine Biosynthesis-Related miRNAs(miRX17,27)**
- **Novel tobacco miRNA (nta)-eTMX27 in regulation of nicotine biosynthesis by acting as a decoy of nta-miRX27 to sequester and degrade nta-miRX27 that targets *QPT2*.**



Fangfang Li et al. (2015)

Fig. 4. Topping-induced expression of endogenous nta-eTMX27 in tobacco root

Group meeting-Brazil 2017

- Meeting Sunday 22 Oct

- Acknowledgements:
  - Dongmei Xu
  - Fabienne Mornet

THANK YOU