

Biology & management of the soybean tentiform leafminer

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Soybean tentiform leafminer

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Brief Communication



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First Reports of *Macrosaccus morrisella* (Lepidoptera: Gracillariidae) Feeding on Soybean, *Glycine max* (Fabales: Fabaceae)

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Abstract

Macrosaccus morrisella (Fitch) is a tiny leaf-mining moth native to North America. In this publication, we provide first reports of this insect feeding on soybean, *Glycine max* (L.) Merr., in Canada and the United States, describe its injury to soybean, and briefly review leaf miners associated with soybean. Further efforts related to *M. morrisella* should focus on its geographic extent of infestation of soybean, impacts to soybean, and ecology in the agricultural landscape.

Key words: leaf miner, host range, pest, soybean

Soybean, *Glycine max* (L.) Merr. (Fabales: Fabaceae), is an important crop to North American agriculture. Because soybean is a non-native crop, the herbivorous insects feeding on it in North America represent native species that have adapted to soybean and exotic species that have invaded (Kogan 1981, Kogan and Turnipseed 1987). Here we provide first reports of infestations of soybean in Canada and the United States by a native leaf-mining moth *Macrosaccus morrisella* (Fitch) (Lepidoptera: Gracillariidae).

Macrosaccus morrisella is widely distributed across eastern North America (Braun 1908, Davis and De Prins 2011). The identification of its life stages is detailed by Braun (1908) and Davis and De Prins (2011). The adults are tiny moths measuring 6–7 mm (Braun 1908). The front wings are patterned with orange, white and gray-black markings (Davis and De Prins 2011). Larvae reach about 4.7 mm in length and are pale green to white in color (Davis and De Prins 2011). The pupae are about 3.6 mm in length (Davis and De Prins 2011). *Macrosaccus* spp. feed on plants in the Fabaceae family (Davis and De Prins 2011). In particular, *M. morrisella* is known

soybean leaves (e.g., Figs. 1 and 2) were collected from a field in Saint-Paul and sent to the Laboratoire d'Expertise et de Diagnostic en Phytprotection (LEDP) for identification. During the following week, infested leaves were collected in Saint-Ambroise-de-Kildare (15 August 2016), Berthierville (18 August 2016), and Nicolet (18 August 2016), and sent to the LEDP. More than 10 mines could be seen on some leaflets. Additional soybean leaves with blotch-type leaf mines were collected from a field in Princeville on 8 July 2019 and from fields in Saint-Gervais and Yamachiche in 2021. Adult insects were reared from infested soybean leaves from each of these locations in Québec.

In Minnesota, United States, leaf mines similar to those in Québec were observed in soybean fields near St. Paul and Rosemount on 13 and 17 August 2021, respectively (e.g., Fig. 3). At both locations, infestations were light with only scattered plants showing symptoms of infestation. From the St. Paul and Rosemount fields, soybean leaves with blotch-type mines were collected. For each leaf, the number of mines, and length and width of each mine was re-

- *Macrosaccus morrisella*
- Lepidoptera: Gracillariidae
- Native insect
- Legume feeder
- Host range expansion

Known host plants



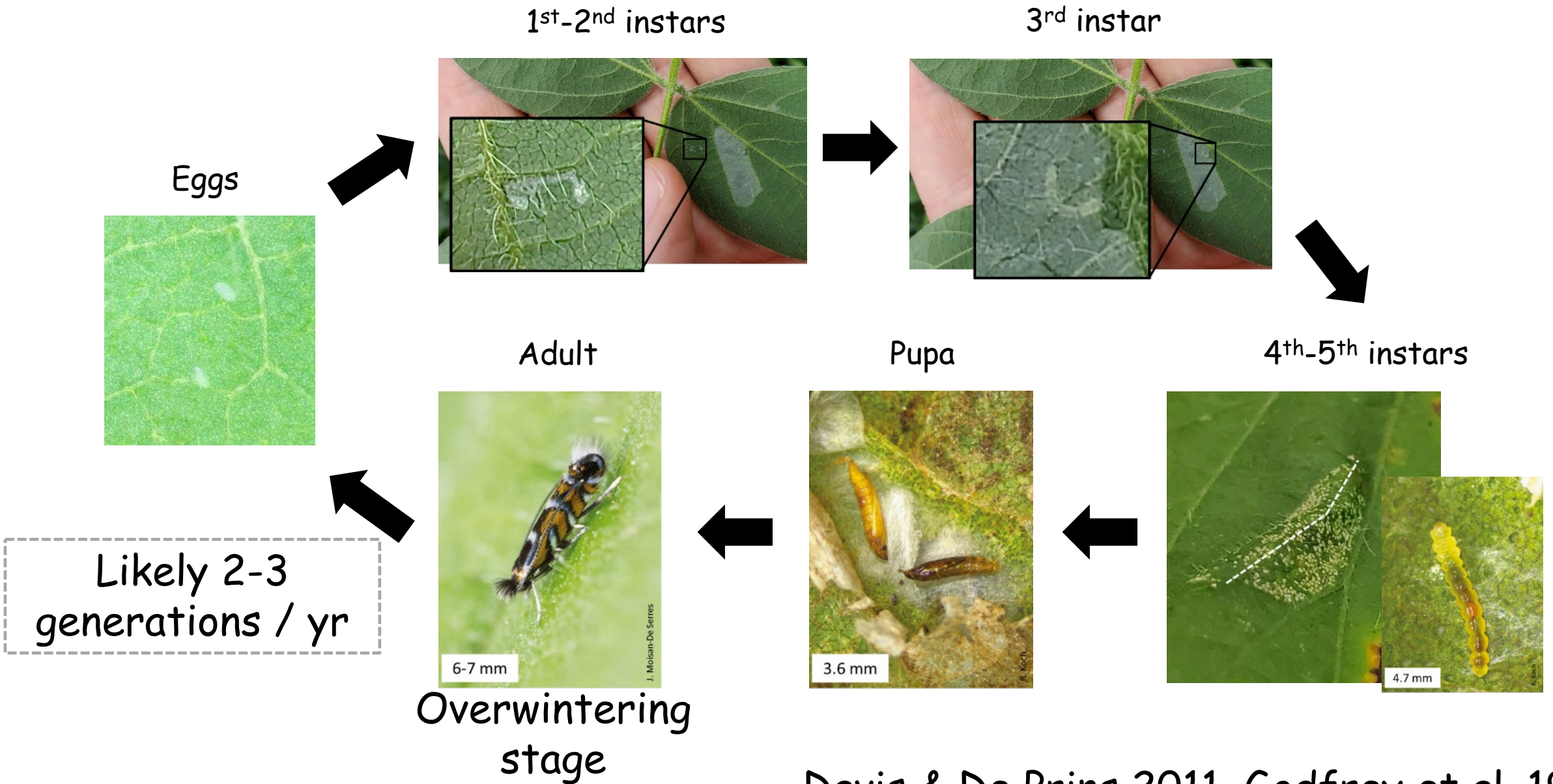
Davis & De Prins 2011, Koch et al. 2021

Adult

- Tiny moth (~1/4")
- Front wings
 - Orange
 - White
 - Gray-black markings



Life cycle

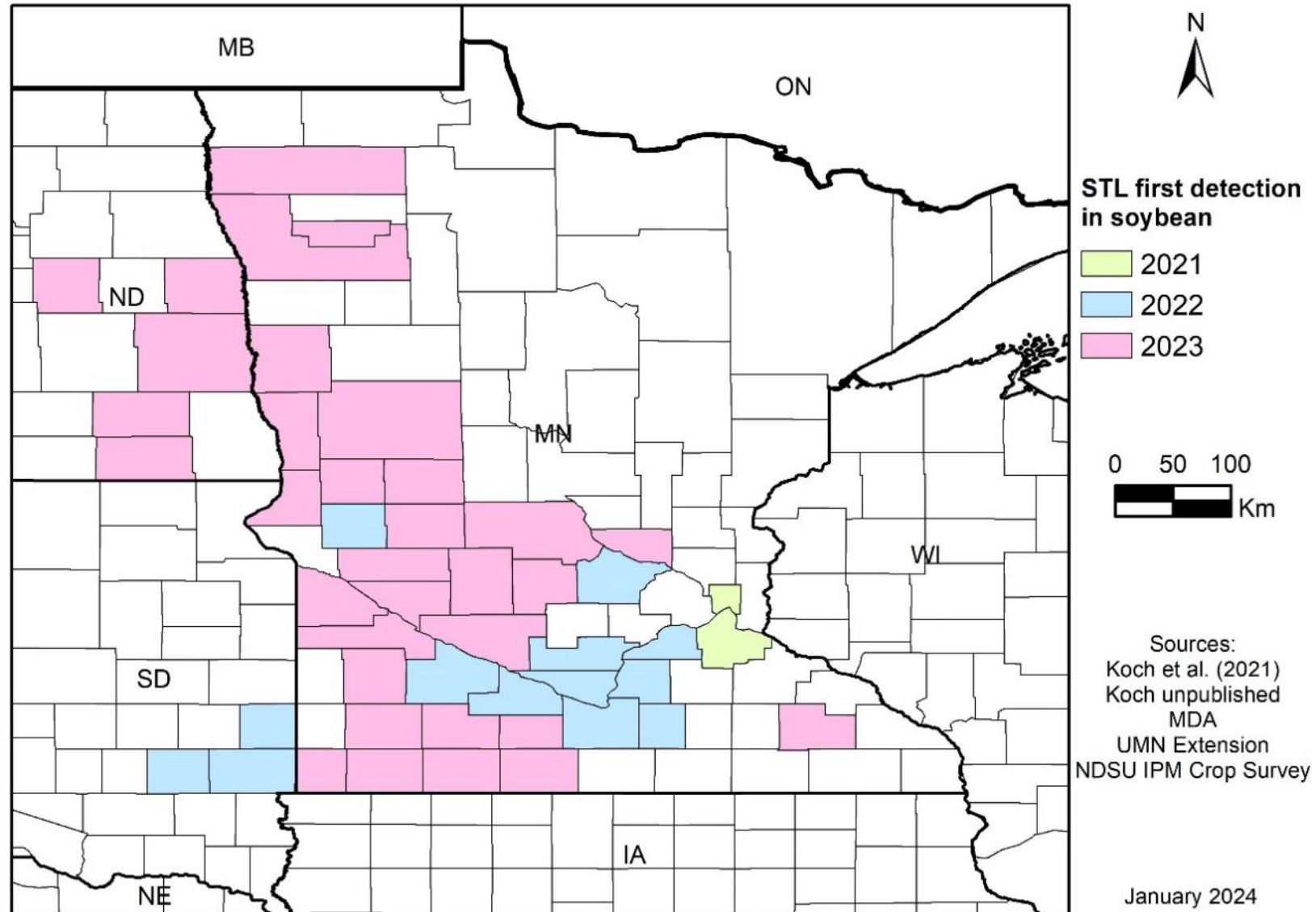


Davis & De Prins 2011, Godfrey et al. 1987

Injury

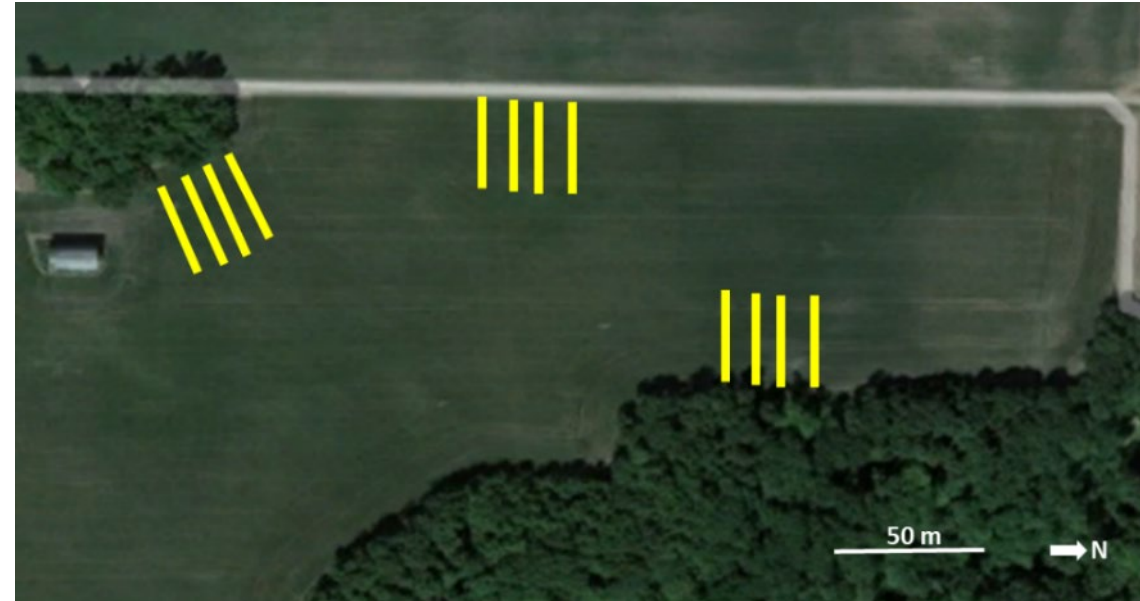


Distribution in soybean

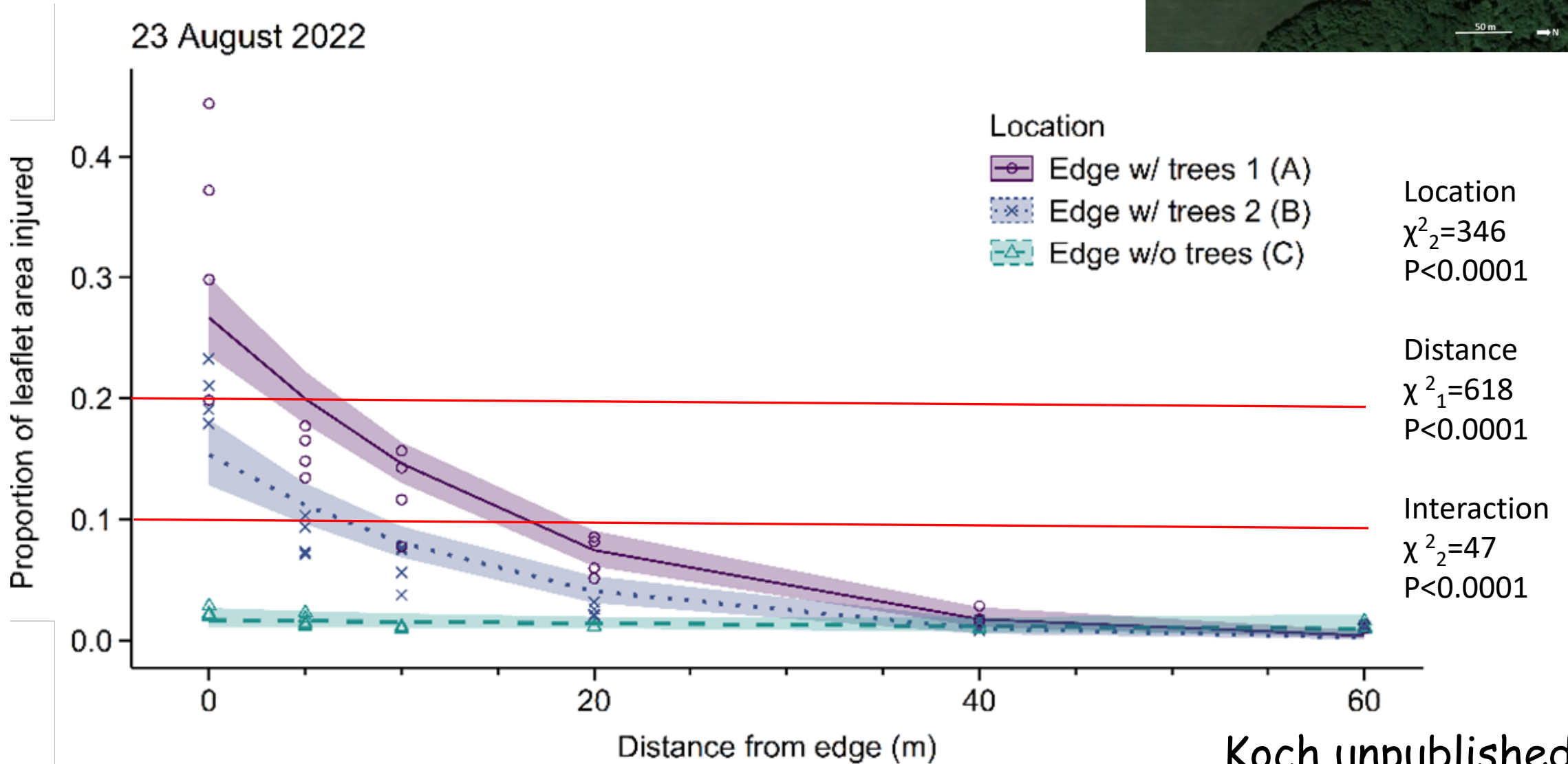
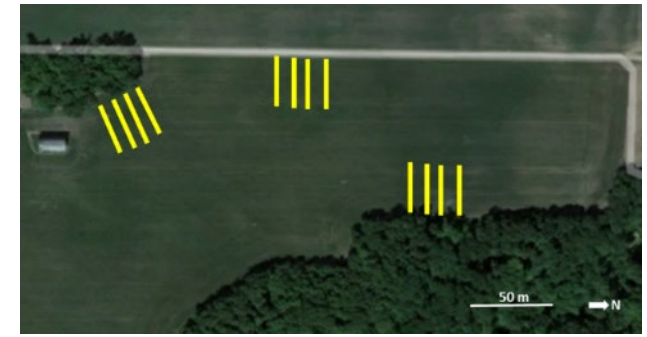


Within-field distribution

- Henderson, MN - 2022
- 3 locations
- 4 transects per location
- 6 sample points per transect
- 15 leaflets per sample point
- Proportion leaf area mined
 - iPad with LeafByte



Within-field distribution

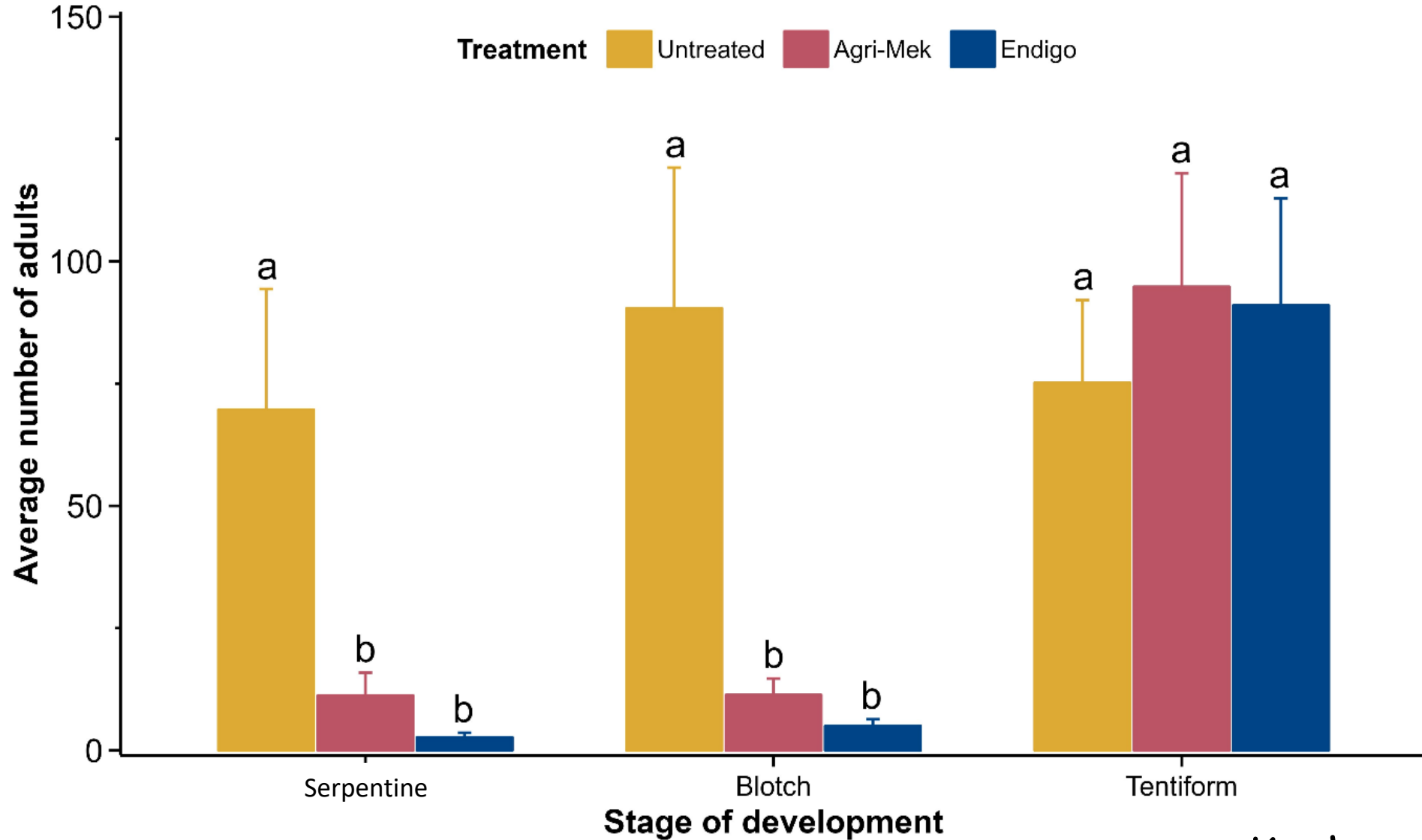


Chemical control - Potted plants

- Randomized complete block
 - 6 replications
- Developmental stages
 - Serpentine mines - 1st-2nd instars
 - Blotch - 3rd instar
 - Tentiform - 4th-5th instars
- Insecticides
 - Agri-Mek SC
 - Endigo ZCX
 - Untreated control
- # of adults emerged



Chemical control - Potted plants



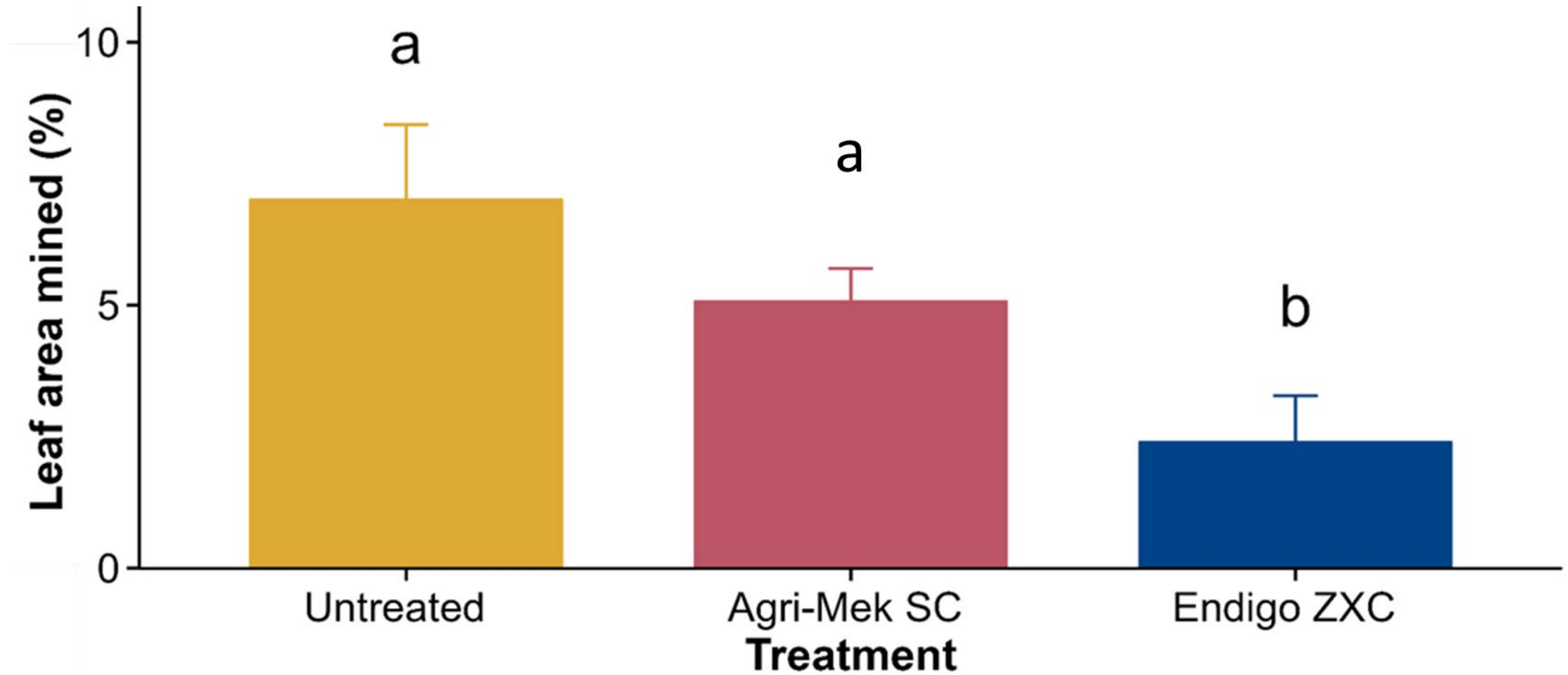
Koch unpublished

Chemical control - Field trial

- Randomized complete block design
 - Plots: 10 feet x 15 feet
 - 4 replications
 - Sprayed: Aug. 11, 2023 (R3 stage)
- Treatments
 - Agri-Mek SC
 - Endigo ZCX
 - Untreated control
- 15 leaflets per plot - 21 DAT
- % leaf area mined



Chemical control - Field trial



Biological control

Parasitoids known to attack soybean tentiform leafminer:

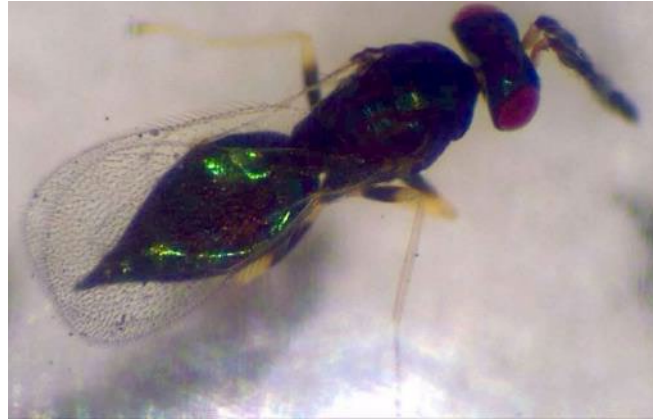
- *Pediobius albipes*
- *Sympiesis marylandensis*

(Peck 1985, Maier 1988)

Biological control



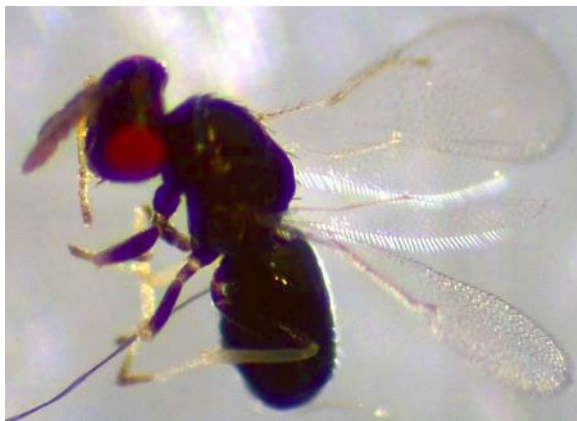
*Zagrammosoma
multilineatum*



Aprostocetus sp.



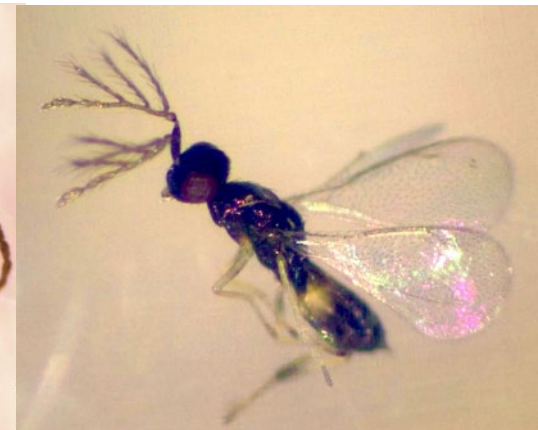
?????



Baryscapus sp.



Tetrastichus sp.



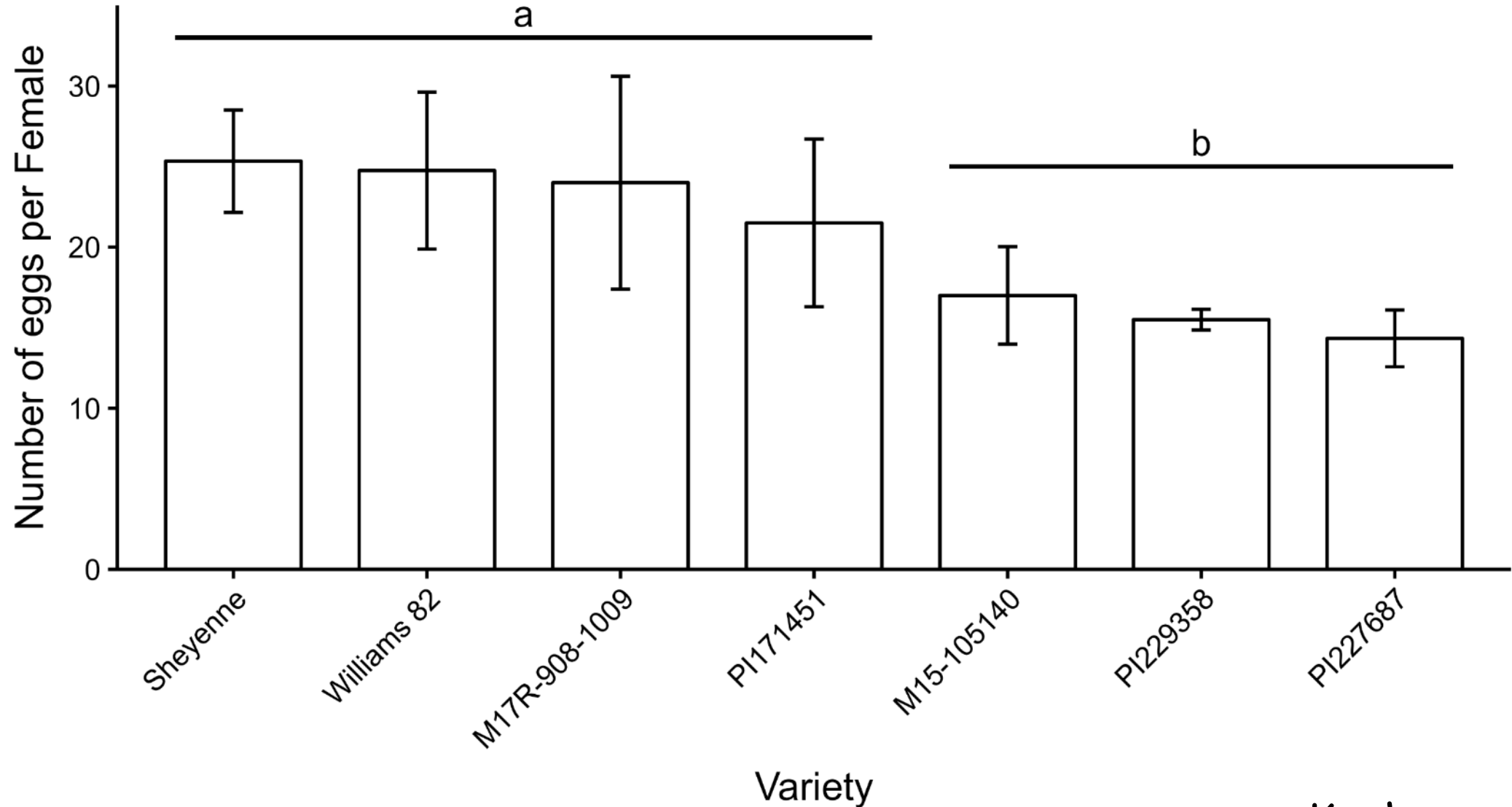
Sympiesis spp.

Soybean resistance- No choice

- Randomized complete block design
 - 4 replications
- Treatments
 - Sheyenne - susceptible
 - Williams82 - susceptible
 - PI171451 - defoliator resistant
 - PI229358 - defoliator resistant
 - PI227687 - defoliator resistant
 - M15-105140 - aphid resistant
 - M17R-908-1009 - aphid resistant
- 10 adults plant
- # of eggs after 24 h of oviposition



Soybean resistance - No choice



Koch unpublished

Host range -choice

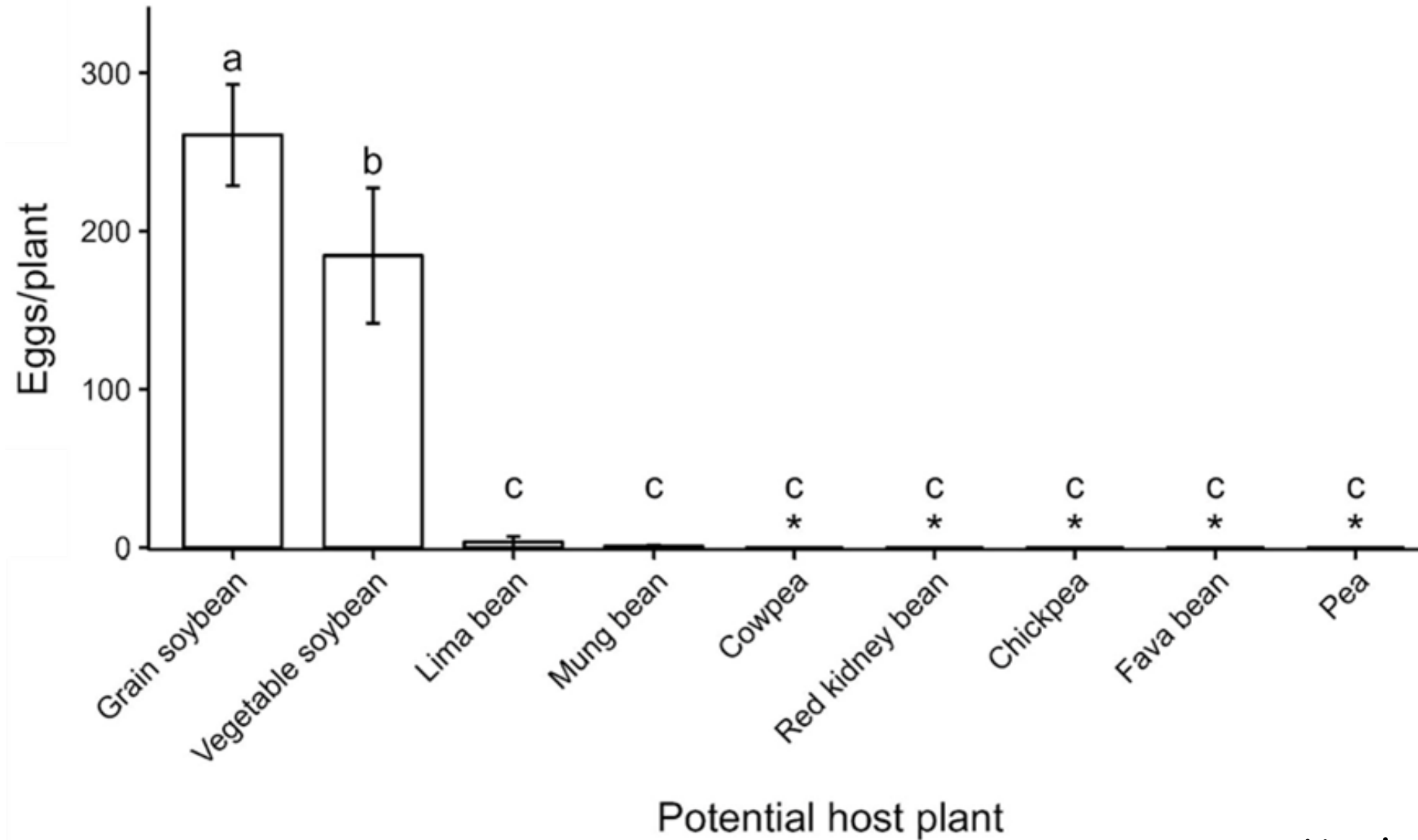
- Randomized complete block design
 - 4 replications
- Treatments
 - *Glycine max* - Edamame
 - *Glycine max* - Grain soybean
 - *Phaseolus vulgaris* - Common bean
 - *Phaseolus lunatus* - Lima bean
 - *Vigna radiata* - Mung bean
- ~70 adults / cage
- # of eggs after 48 h of oviposition



- *Vigna unguiculata* - Cowpea
- *Vicia faba* - Fava bean
- *Pisum sativum* - Pea
- *Cicer arietinum* - Chickpea



Host range - Choice



Host range - No choice

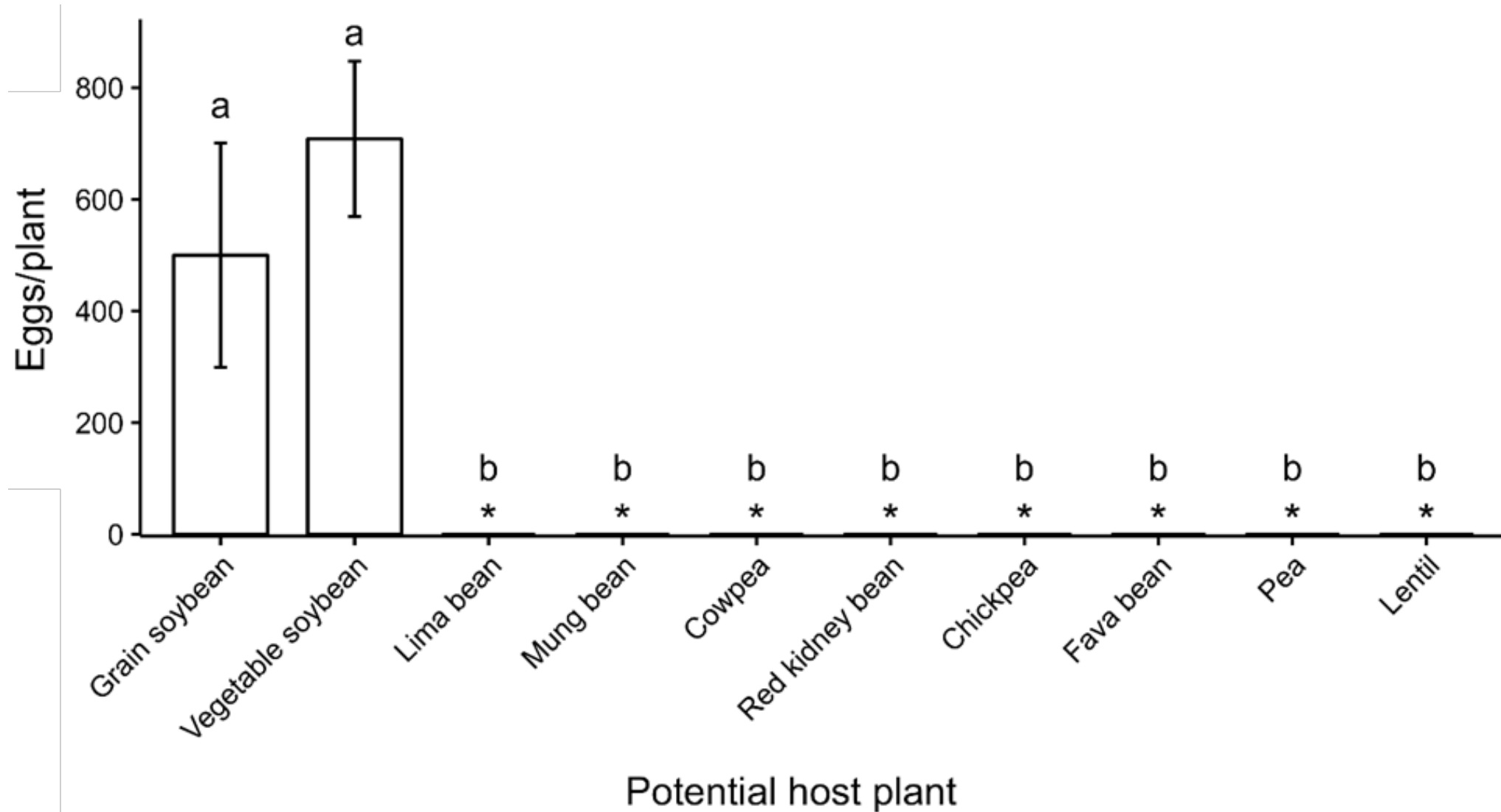
- Randomized complete block design
 - 4 replications
- Treatments
 - *Glycine max* - Edamame
 - *Glycine max* - Grain soybean
 - *Phaseolus vulgaris* - Common bean
 - *Phaseolus lunatus* - Lima bean
 - *Vigna radiata* - Mung bean
- ~35 adults plant
- # of eggs after 72 h of oviposition



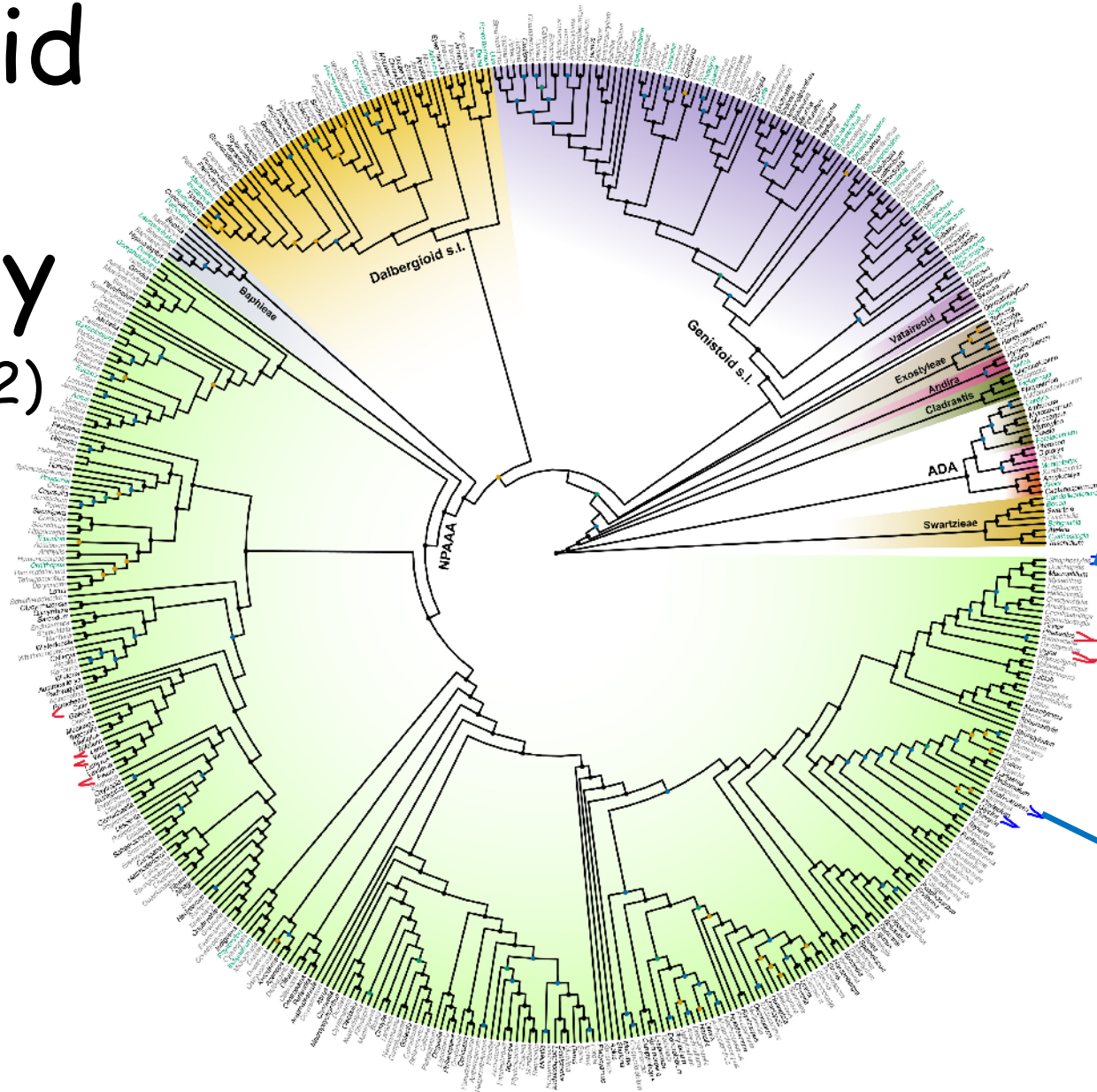
- *Vigna unguiculata* - Cowpea
- *Vicia faba* - Fava bean
- *Pisum sativum* - Pea
- *Cicer arietinum* - Chickpea
- **Lens culinaris* - Lentil*



Host range - No choice



Papilionoid legume phylogeny (Choi et al. 2022)

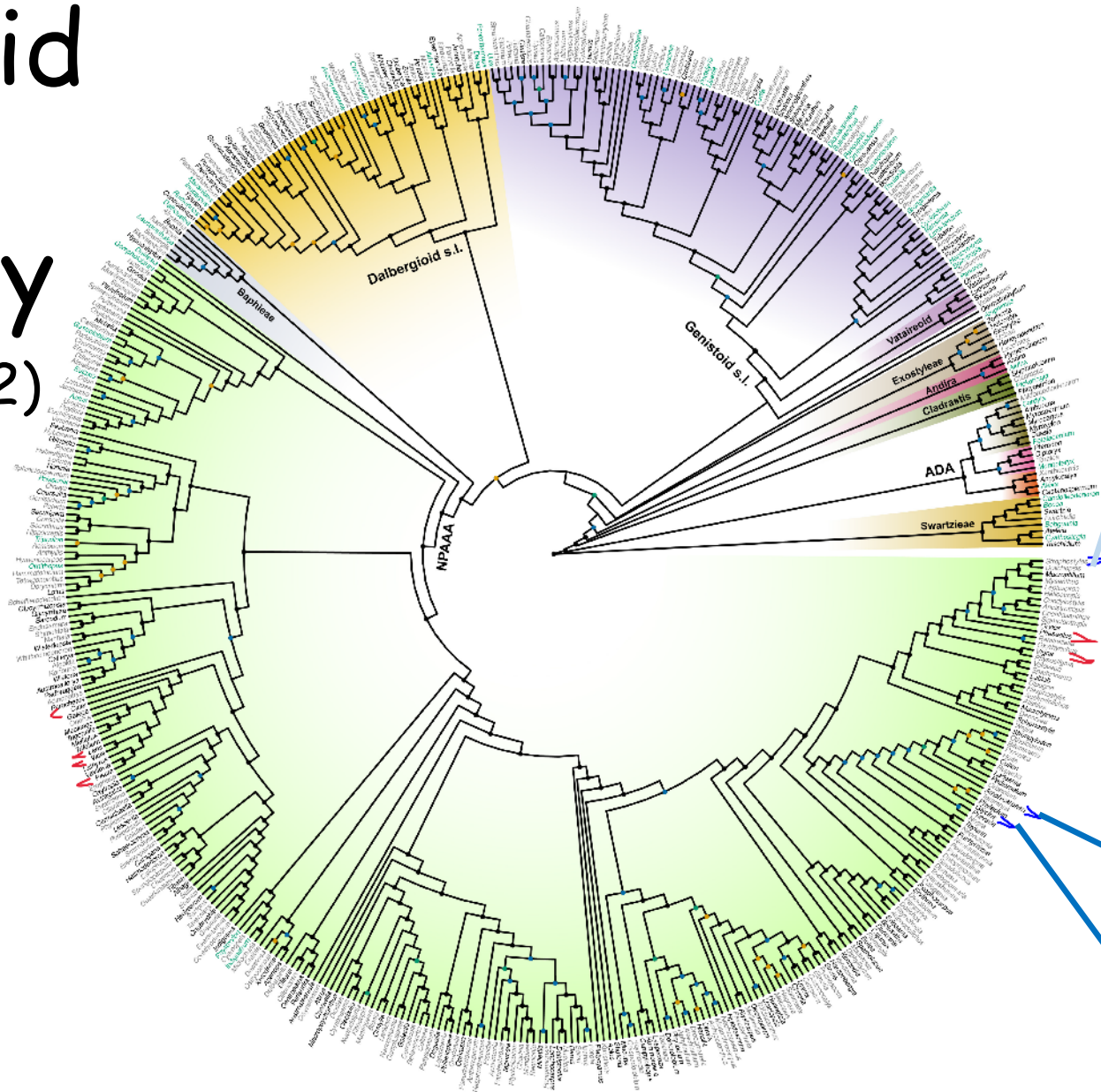


Slickseed
fuzzybean

American
hogpeanut

Papilionoid legume phylogeny

(Choi et al. 2022)



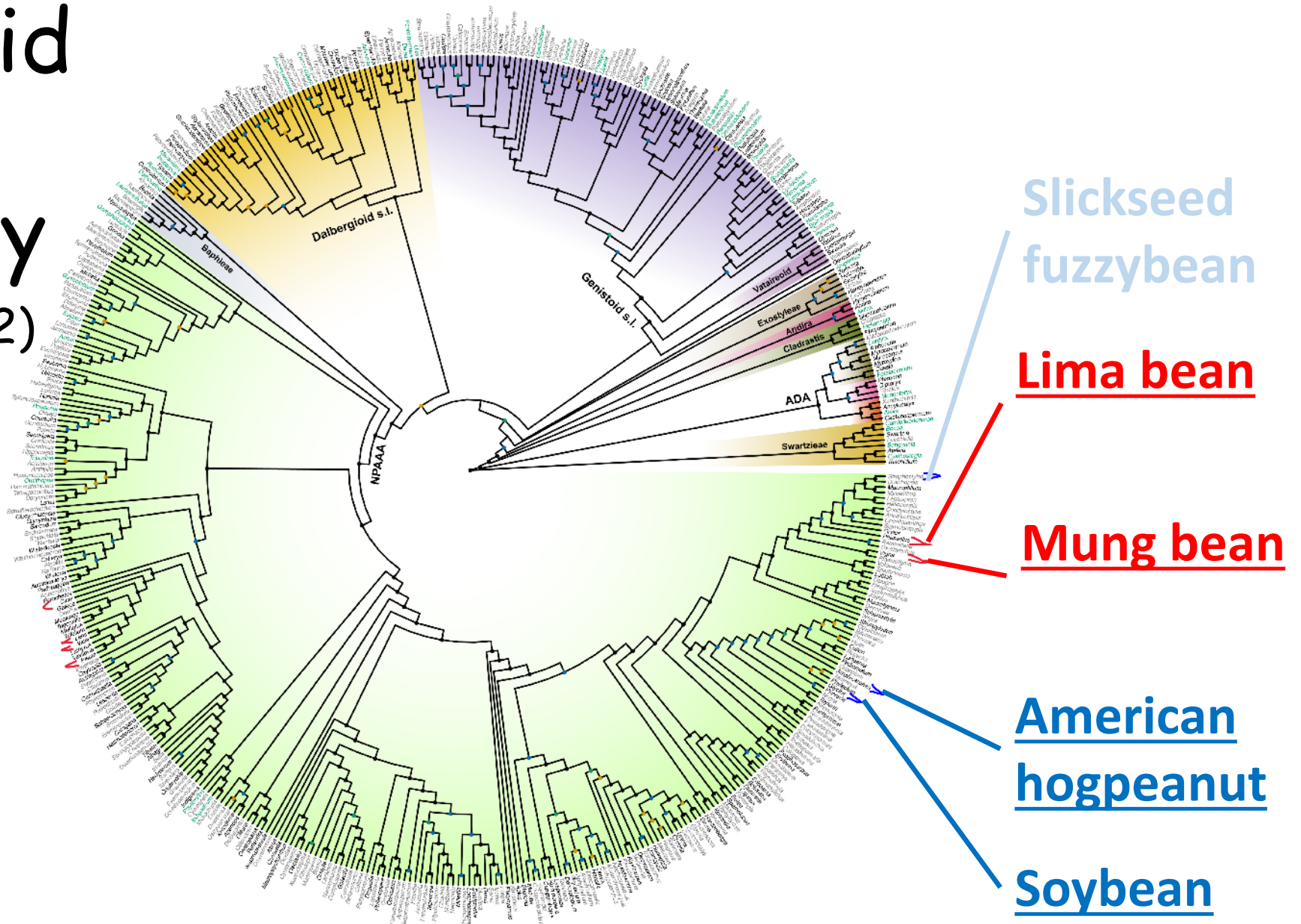
Slickseed
fuzzybean

American
hogpeanut

Soybean

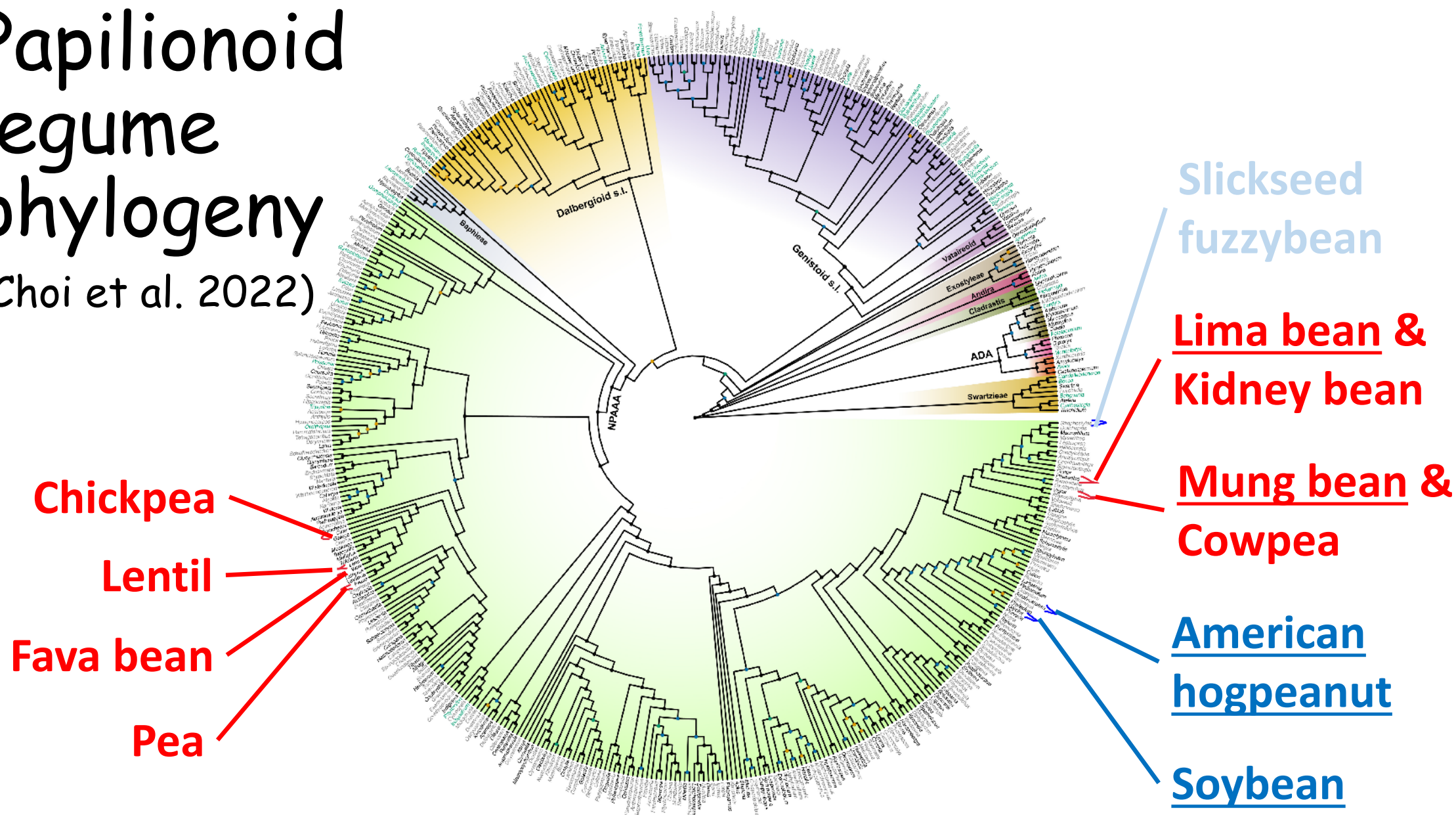
Papilionoid legume phylogeny

(Choi et al. 2022)



Papilionoid legume phylogeny

(Choi et al. 2022)



Summary

- Widespread in soybean
 - MN, eastern SD/ND
- Strong edge effects
 - Edges with trees
- Chemical control
 - Target early instars with translaminar insecticides
- Biological control
 - Attacked by several parasitoids
- Host range
 - Primarily limited to soybean & native hosts



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