

Cotton leafroll dwarf virus: opening the locks in Georgia

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Our coffee-table discussion in 2020-21-22...?

VIRUS

Variant

Mutate

Strain

RT-PCR

Genome

Sequencing

Transmission

Incidence

Asymptomatic

Antigen

Avoidance

Vector/ carrier

Symptomatic

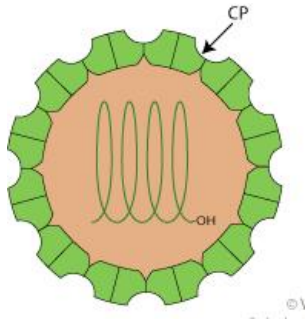
Protein

Resistance

PCR

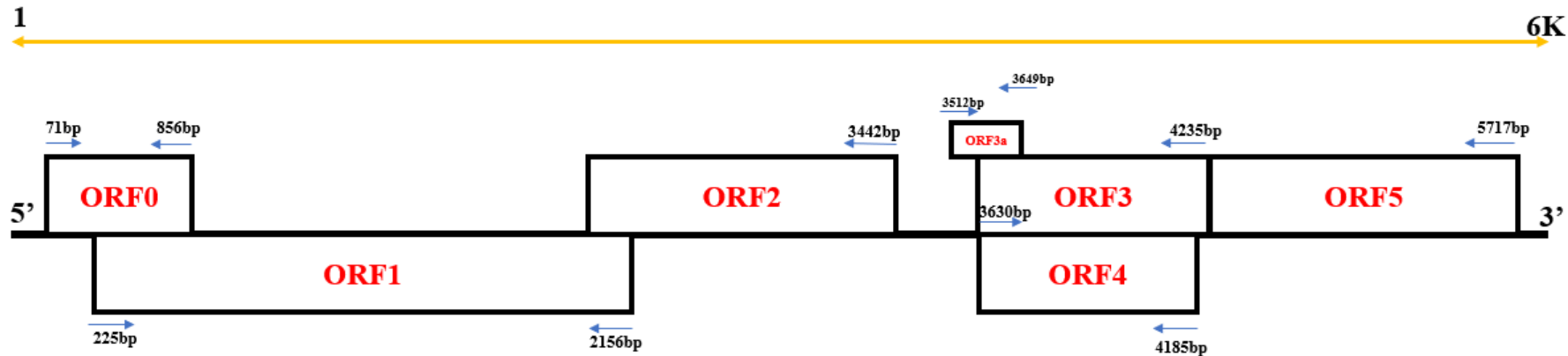
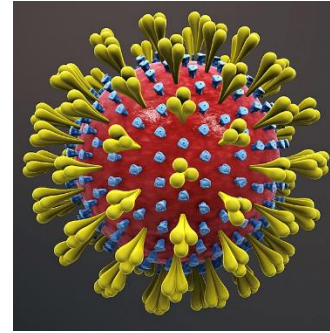
Antibody

Cotton leafroll dwarf virus genome organization



SARS-CoV-2 (COVID-19): Single Stranded, Positive Sense RNA, **29.9kb**

CLRDD (CLRDD): Single Stranded, Positive Sense RNA, **5.8kb**



Open Reading Frame	Protein	Function
ORF 0	P0 (28.9 kDa)	Silencing Suppressor
ORF1-2	P1-2 (118.7kDa)	Replication
ORF-3	P3 (22.1 kDa)	Coat Protein
ORF-3a	P3a	Support virus movement
ORF-4	P4 (19.4 kDa)	Movement Protein
ORF-5	P3-5 (77.2 kDa)	Aphid Transmission

List of cotton leafroll dwarf virus isolates collected and sequenced in this study

Location (County, State)	GenBank Accession number	Symptoms	Date of collection
Tifton, Tift, GA	MT800932	Leaf deformation, curling, red leaves and petiole	07/18/2018
Brookfield, Tift, GA	MT814776	Red leaves and petioles, drooping	08/16/2018
Seminole, GA	MT633122	Leaf distortion and red petiole	09/19/2018
Baldwin, AL	MT814777	Leaf deformation, bunching top, leathery texture	11/08/2018
Bulloch, GA	MT800933	basal regrowth and extended growth	11/14/2018
Dodge, GA	MT814775	Basal regrowth	11/14/2018
Dooly, GA	MT814774	Shortened internodes	11/14/2018

Cotton leafroll dwarf virus symptoms observed in Georgia and Alabama (2018)



(A)



(B)



(C)



(D)



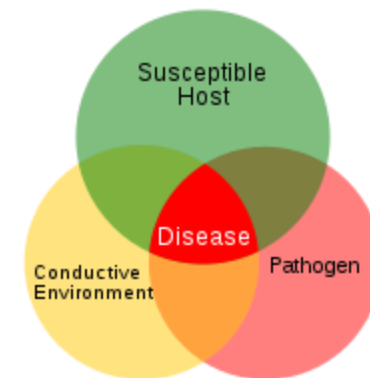
(E)



(F)



(G)

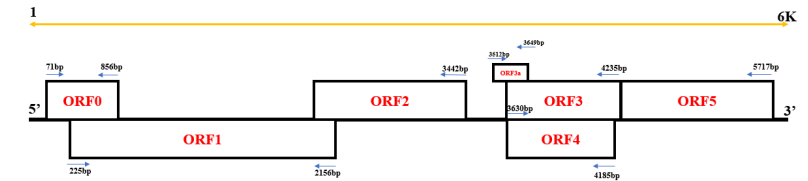
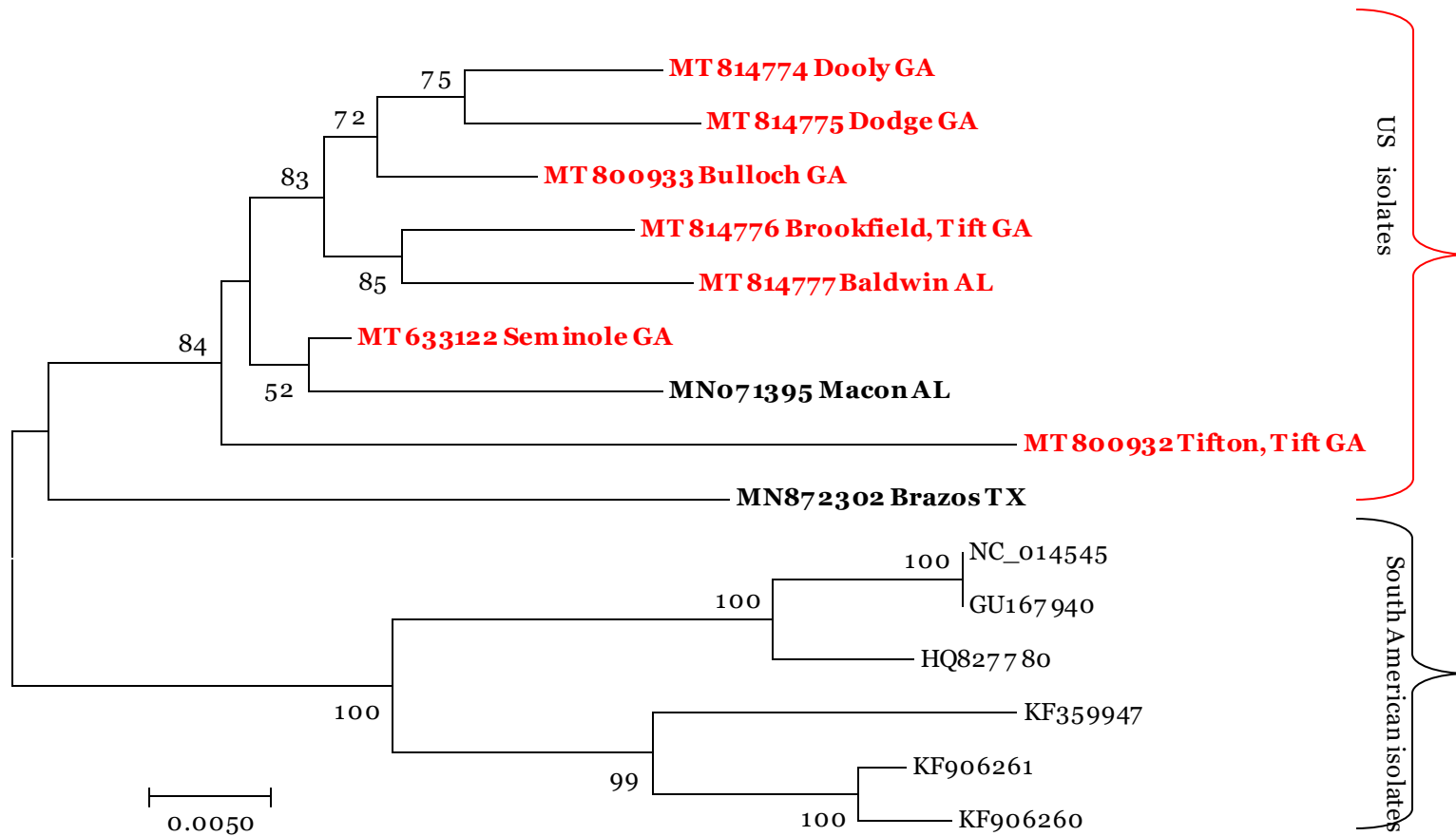


- A. Tifton, Tift County, GA
- B. Seminole County, GA
- C. Brookfield, Tift County, GA
- D. Bulloch County, GA
- E. Dooly County, GA
- F. Dodge County, GA
- G. Baldwin County, AL

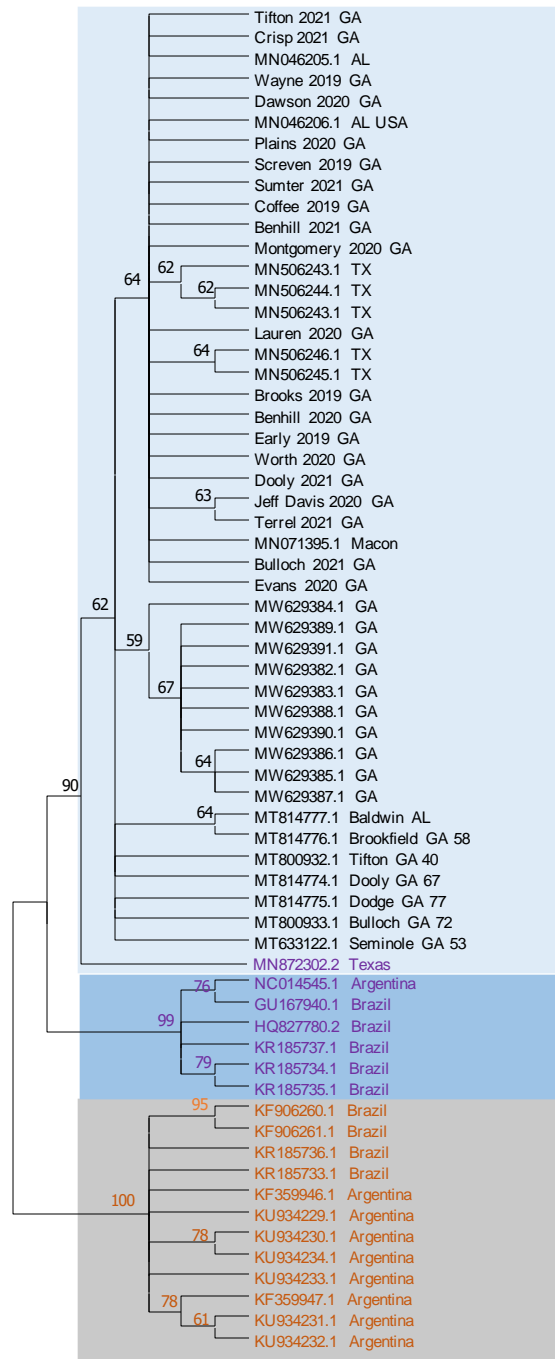
Cotton leafroll dwarf virus in the USA

CLRDV vs CBD

- US isolates formed separate clade from South American isolates.



Cotton leafroll dwarf disease: Variants

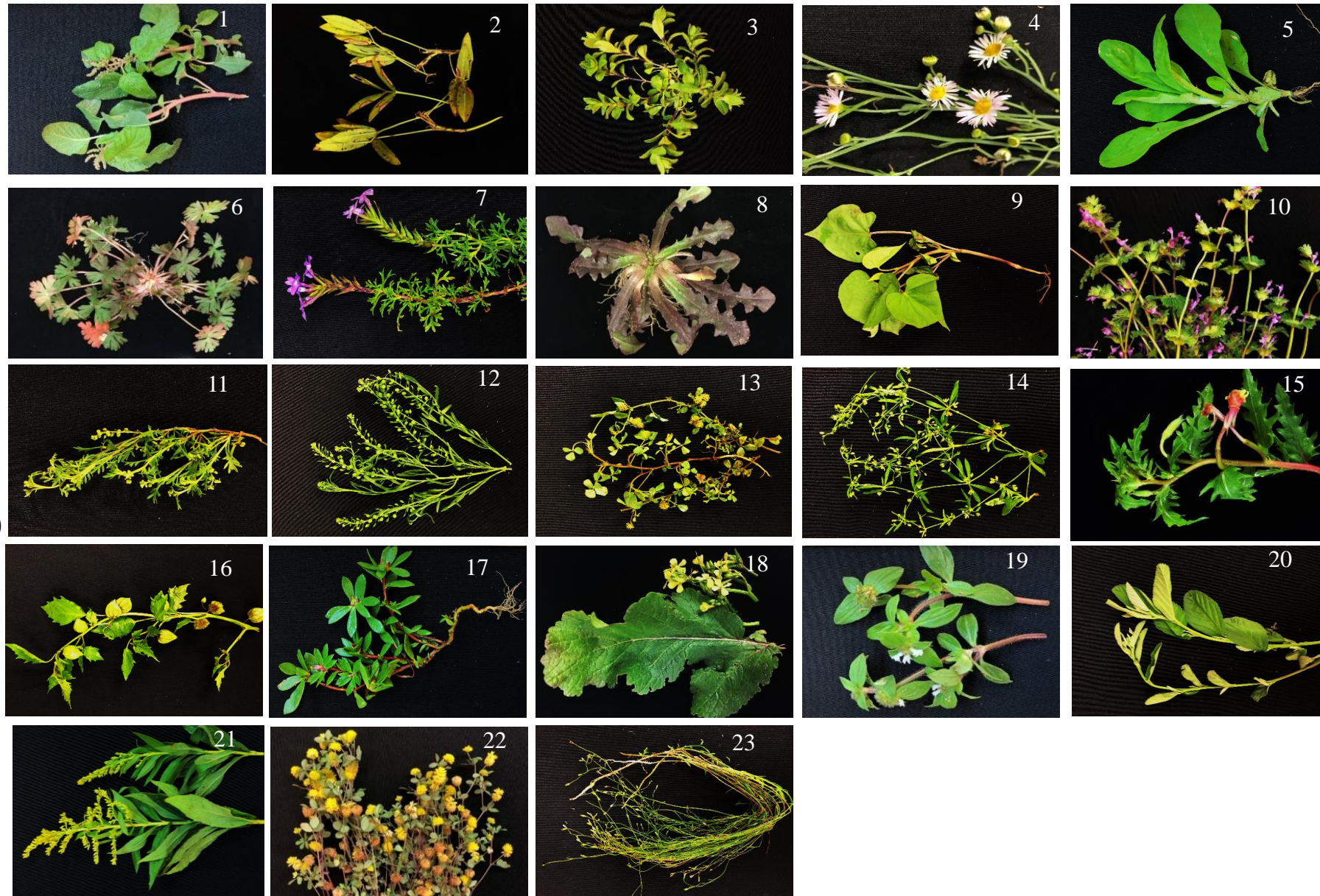


Cotton leafroll dwarf virus: weed hosts

CLRDV Detected:

23 different weeds from 15 species

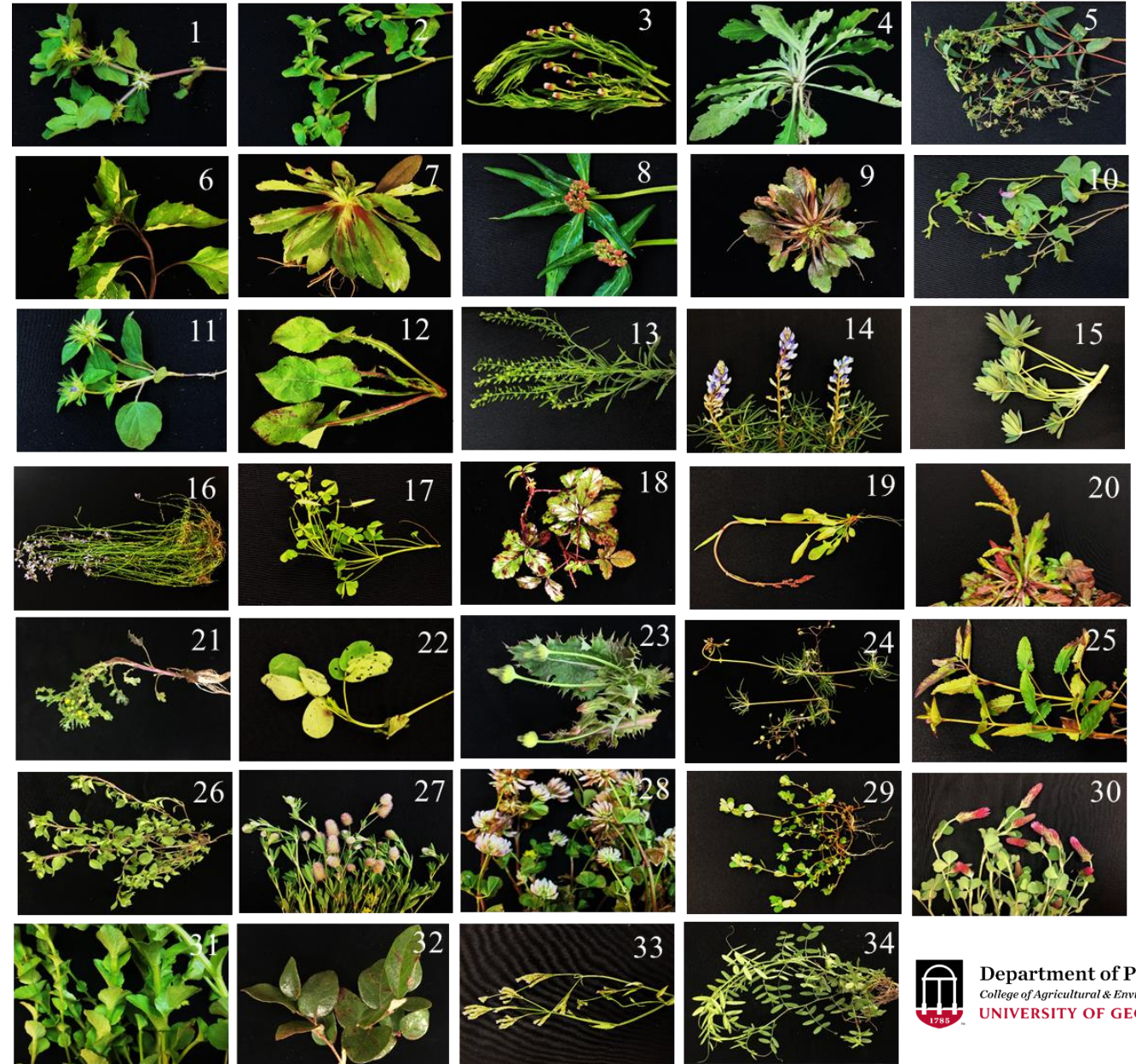
- (1) *Amaranthus palmeri* (Pigweed)
- (2) *Arachis glabrata* (Perennial peanut)
- (3) *Cerastium glomeratum* (Mouse-ear chickweed)
- (4) *Erigeron annuus* (Daisy fleabane)
- (5) *Gamochaeta pensylvanica* (Cudweed)
- (6) *Geranium carolinianum* (Geranium)
- (7) *Glandularia pulchella* (Mock vervain)
- (8) *Hypochaeris radicata* (Flatweed)
- (9) *Jacquemonita tamnifolia* (Morning glory)
- (10) *Lamium amplexicaule* (Henbit deadnettle)
- (11) *Lepidium coronopus* (Swinecress)
- (12) *Lepidium virginicum* (Virginia pepperweed)
- (13) *Medicago polymorpha* (Burr clover)
- (14) *Mollugo verticillate* (Green carpet weed)
- (15) *Oenothera laciniata* (Cutleaf evening primrose)
- (16) *Physalis minima* (Ground cherry)
- (17) *Portulaca Pilosa* (Pink purslane)
- (18) *Raphanus raphanistrum* (Wild radish)
- (19) *Richardia scabra* (Florida parsley)
- (20) *Sida rhombifolia* (Arrowleaf Sida)
- (21) *Solidago altissima* (Golden rod)
- (22) *Trifolium campestre* (Low hop clover)
- (23) *Wahlenbergia marginata* (Southern rock bell)



Cotton leafroll dwarf virus: weed non-host

CLRDV not detected

- (1) *Acanthospermum hispidum* (Bristly starbur)
- (2) *Commelina benghalensis* (Tropical spiderwort)
- (3) *Conyza bonariensis* (Erigeron)
- (4) *Conyza canadensis* (Horseweed)
- (5) *Croton* spp. (Tropic croton)
- (6) *Dhutara angalata* (Dhatura)
- (7) *Erigeron* sp. (Horseweed),
- (8) *Euphorbia heterophylla* (Wild poinsettia)
- (9) *Hypochaeris* sp. (Dandelion)
- (10) *Ipomoea hederacea* (Ivy leaf morning glory)
- (11) *Jacquemonita tamnifolia* (Small flower morning glory)
- (12) *Lactuca floridana* (Wild lettuce)
- (13) *Lepidium virginicum* (Virginia pepperweed)
- (14) *Lupinus angustifolius* (Blue lupin)
- (15) *Lupinus luteus* (Yellow lupin)
- (16) *Nuttallanthus canadensis* (Blue toadflax)
- (17) *Oxalis stricta* (Yellow woodsorrel)
- (18) *Rubus flagellaris* (Dewberry)
- (19) *Rumex hastatulus* (Heartwing dock)
- (20) *Salvia lyrata* (Lyreleaf sage)
- (21) *Senecio vulgaris* (Groundsel)
- (22) *Senna obtusifolia* (Sicklepod)
- (23) *Sonchus asper* (Spiny leafed sow-thistle)
- (24) *Spergula arvensis* (Corn spurry)
- (25) *Stachys floridana* (Florida betony)
- (26) *Stellaria media* (Chickweed)
- (27) *Trifolium arvense* (Hare's foot clover)
- (28) *Trifolium carolinianum* (Carolina clover)
- (29) *Trifolium dubium* (Trifolium)
- (30) *Trifolium incarnatum* (Crimson clover)
- (31) *Triodanis perfoliata* (Clasping bellwort)
- (32) *Vaccinium arboretum* (Farkleberry)
- (33) *Verbena* sp. (Blue vervain)
- (34) *Vicia sativa* (common vetch)



Overwintering of cotton leafroll dwarf virus on stalks

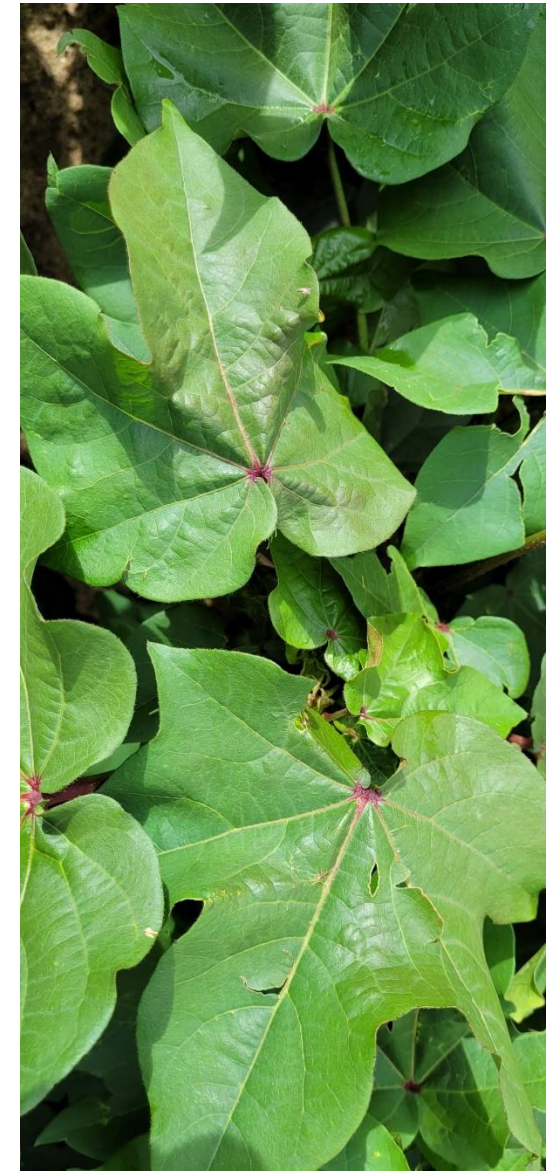
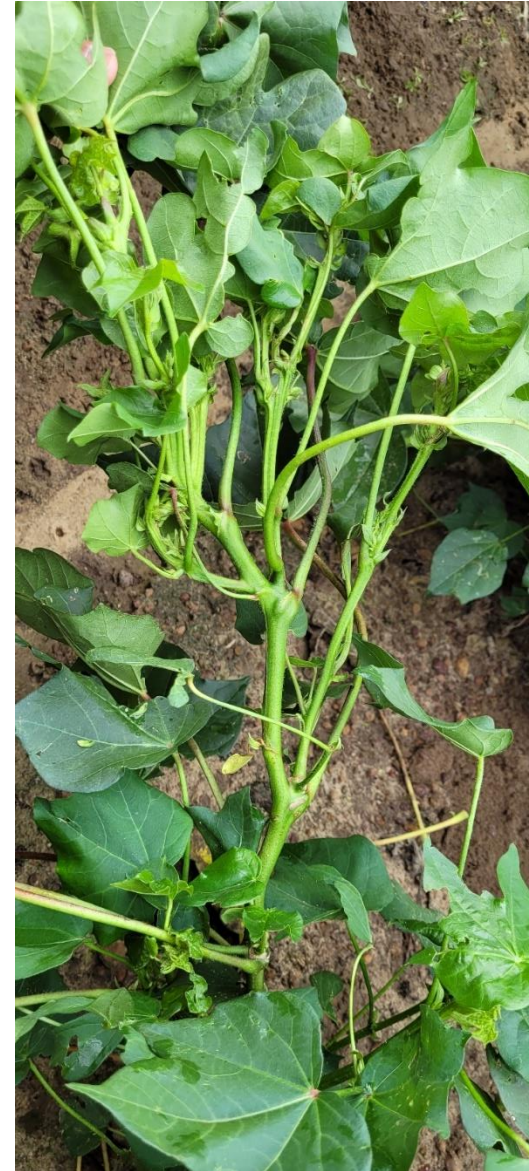


S. N	Collection Time	Location (County)	Total number of samples	Number of stalks per pool	Number of positive /Number of test
Volunteer stalks (Pooled)					
1	March 2019	Berrien	16	8	0/2
2	March 2019	Seminole	63	7	3/9
3	March 2019	Tift	4	2	1/2
4	March 2019	Worth	15	5	1/3
5	April 2019	Dodge	8	4	1/2
6	April 2019	Terrell	8	4	0/2
	TOTAL		114		6/22
Volunteer stalks (Individual)					
7	February 2019	Colquitt	10	—	5/10
8	March 2019	Dooley	1	—	0/1
9	March 2019	Mitchell	2	—	0/2
10	June 2019	Tift	30	—	13/30
11	July 2019	Grady	1	—	1/1
12	March 2020	Jefferson	3	—	2/3
13	March 2020	Wilcox	5	—	4/5
	TOTAL		52		25/52
Cotton regrowth leaves (Individual)					
14	April 2020	Tift	40	—	31/40
15	May 2020	Ben Hill	39	—	39/39
16	May 2020	Tift	51	—	27/51
17	June 2020	Tift	20	—	16/20
	TOTAL		150		113/150

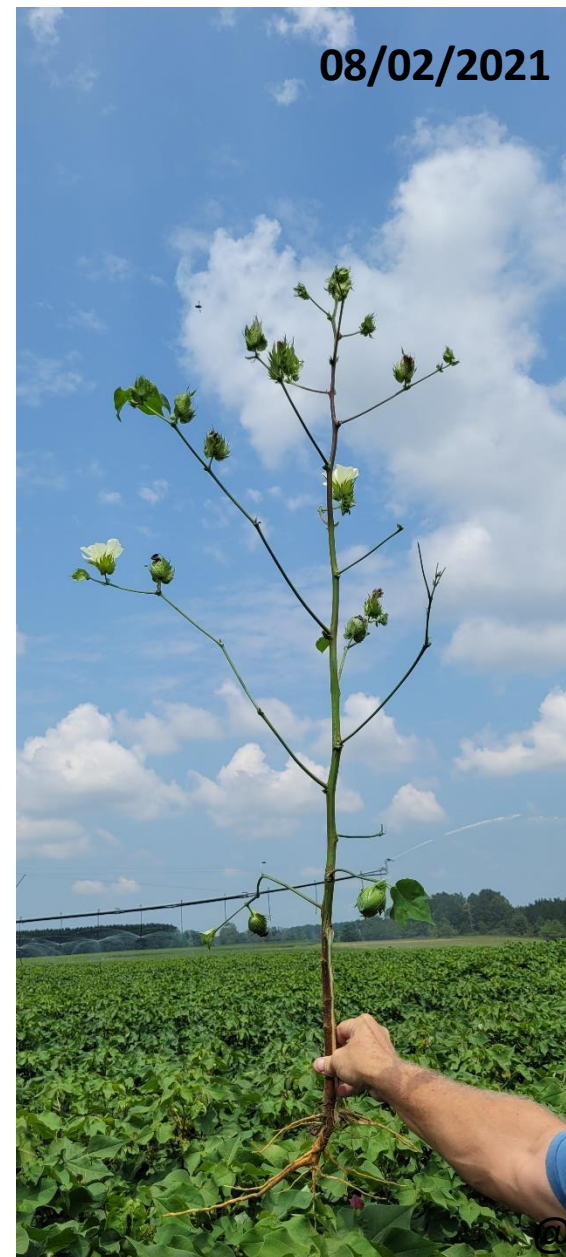


Cotton leafroll dwarf disease: symptoms (Terrell county)

07/21/2021



Cotton leafroll dwarf disease: symptoms (Sumter county)



Cotton leafroll dwarf disease: symptoms (Colquitt county)



10/13/2021

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Cotton leafroll dwarf disease: Impact (Tift county)

Symptomatic @90 days

Asymptomatic @90 days



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Planted on 06/02/2021
Harvested on 11/08/2021

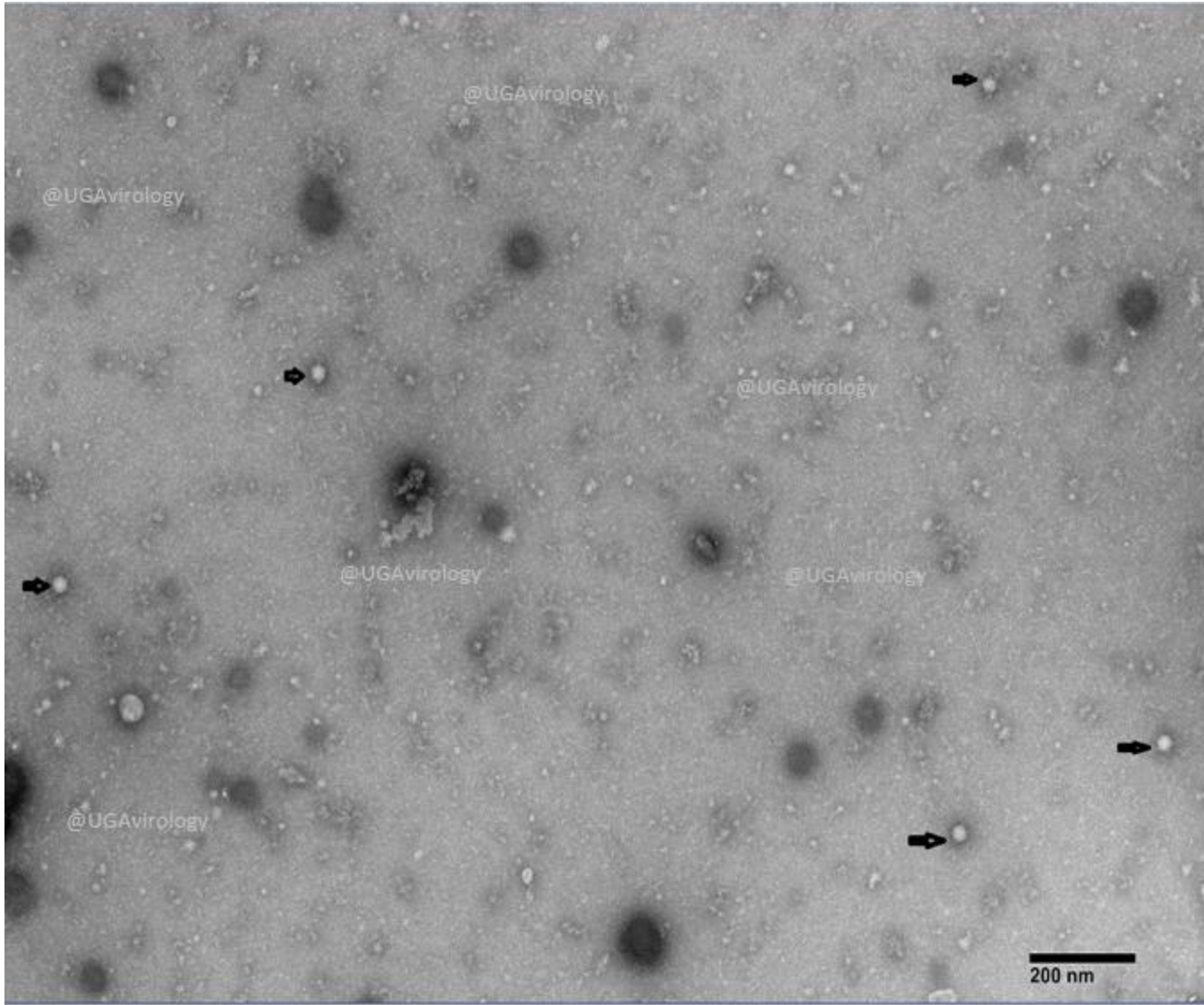
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Cotton leafroll dwarf disease: Impact (Tift county)



Cotton leafroll dwarf virus



- Non-enveloped, spherical virion
- ~23 nm in diameter

Cotton leafroll dwarf disease: 2021 update

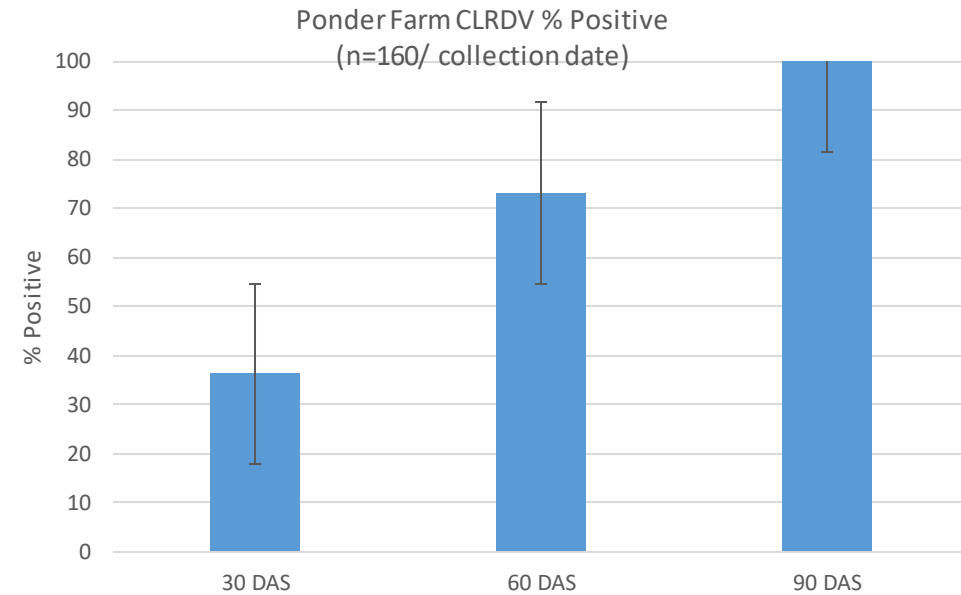
CLRDV Survey - Counties of Georgia 2021

CLRDV Present in 16 of 17 Counties tested

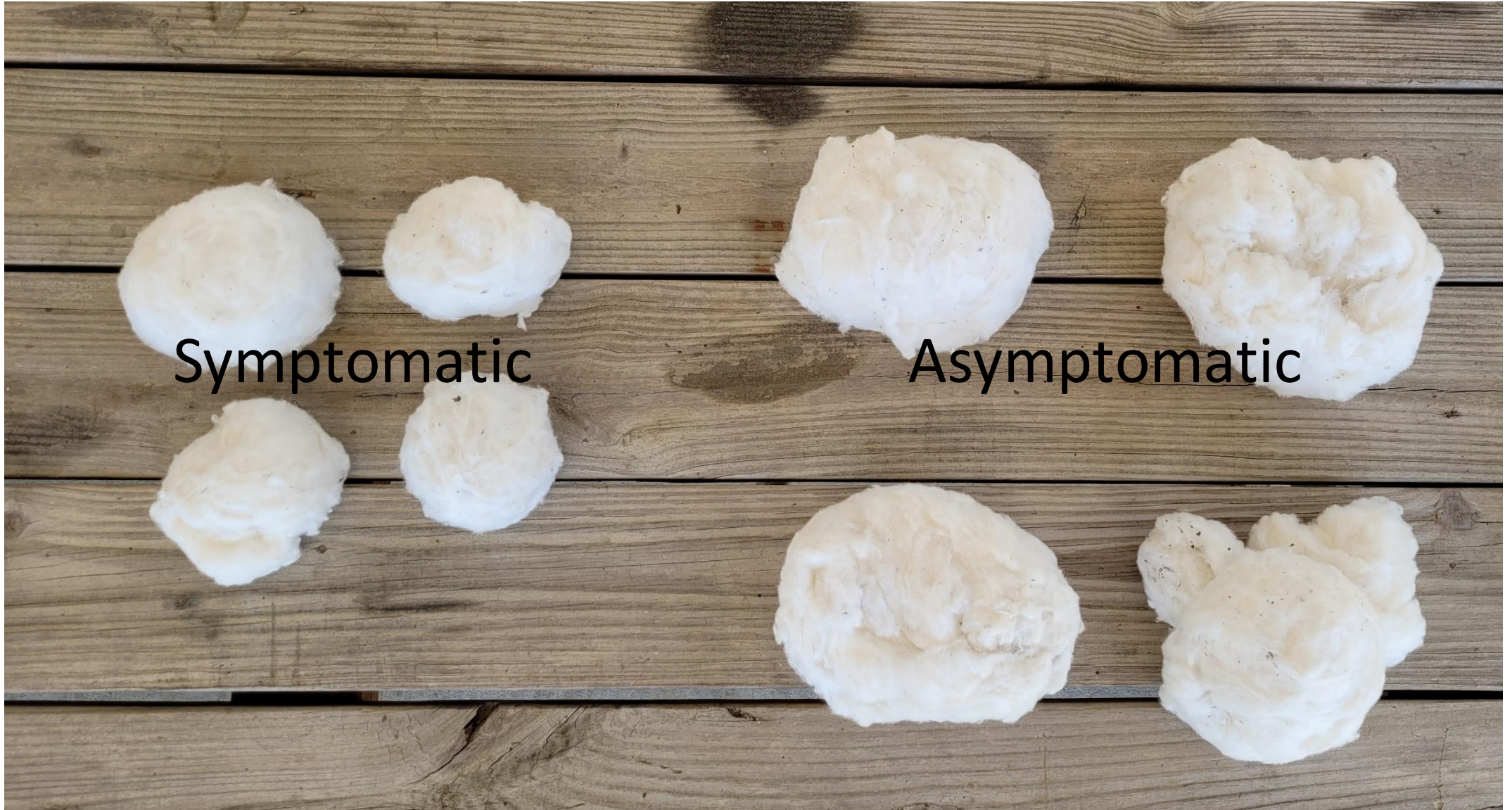
Samples Collected	Tested	Positive	% Positive
119	119	94	78.99

CLRDV Cotton Research Projects

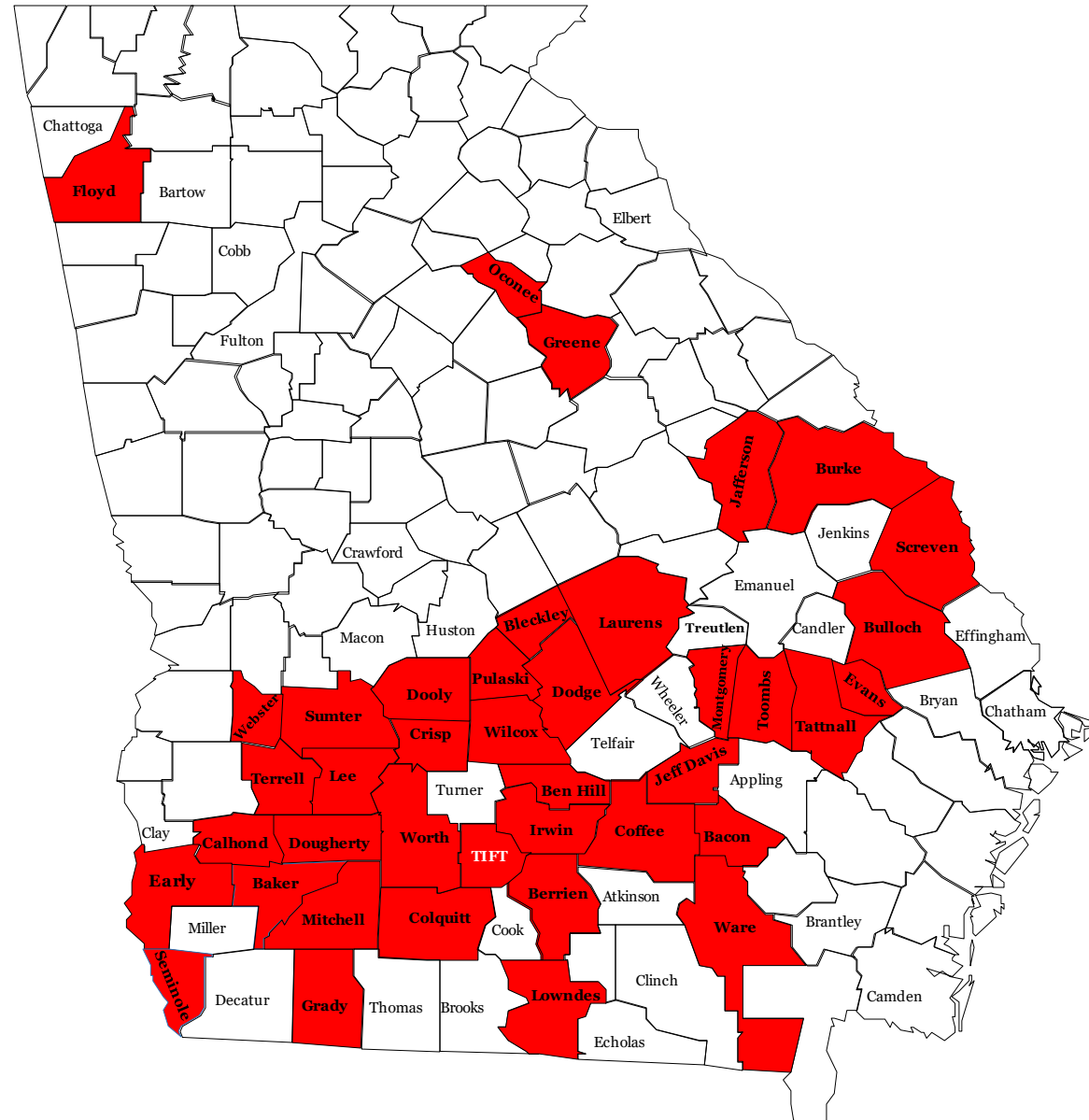
Samples Collected	Tested	Positive	% Positive
4705	3390	889	26.22



Cotton leafroll dwarf disease: Impact



Cotton leafroll dwarf disease: Geographical distribution in GA 2018-2021



Cotton leafroll dwarf disease: Ongoing experiments

- Planting date and its influence on disease incidence and lint yield.
- Current cultural practices and CLRDV disease incidence
- Assessing chemical control for CLRDV and its impact on yield.
- Developing molecular tools to investigate host-virus interaction.



Research publication on Cotton from UGA-Cotton team on CLRDV (2019-2021)

1. Tabassum, A., **Bag S.**, Suassuna, N. D., Conner, K. N., Chee, P., Kemerait, R.C., and Roberts, P. (2021). Genome analysis of cotton leafroll dwarf virus reveals variability in the silencing suppressor protein, genotypes, and genomic recombinants in the USA. *PLoS ONE*. 16(7): e0252523. <https://doi.org/10.1371/journal.pone.0252523>
2. Sedhain, N. P., **Bag, S.**, Carter, R., Morgan, K., Triana, P., Kemerait, R. C., Roberts, P. M. (2021). Natural host range, incidence on overwintering cotton and diversity of cotton leafroll dwarf virus in Georgia USA. *Crop Protection*. 144:105604. <https://doi.org/10.1016/j.cropro.2021.105604>
3. Bag, S., Roberts P. M., and Kemerait R.C. (2021). Cotton leafroll dwarf virus: an emerging virus disease on cotton in the US. *Crops and Soils*. 54:2, 18-22. (Feature Article). <https://doi.org/10.1002/crso.20105>
4. Parkash, V., Sharma, D.B., Snider, J.L., **Bag, S.**, Roberts, P.M., Tabassum, A., West, D., Khanal, S., Suassuna, N., and Chee. P. (2021). Effect of cotton leafroll dwarf virus on physiological processes and yield of individual cotton plants. *Frontiers in Plant Science*. 12:734386. <https://doi.org/10.3389/fpls.2021.734386>
5. Tabassum, A., Roberts, P. M., and **Bag, S.** (2020). Genome Sequence of cotton leafroll dwarf virus infecting cotton in Georgia, USA. *Microbiol Resource Announcement*. 9(34). <https://doi.org/10.1128/MRA.00812-20>
6. Tabassum, A., **Bag, S.**, Roberts, P., Suassuna, N., Chee, P., Whitaker, J.R., Conner, K.N., Brown, J., Nichols, R.L., and Kemerait, R.C. (2019). First report of cotton leafroll dwarf virus infecting cotton in Georgia, U.S.A. *Plant Disease* 103 (7):1803. <https://doi.org/10.1094/PDIS-12-18-2197-PDN>

Team Members (Lab Members)

Past members (2018-2020)

Afsha Tabassum (Post-Doc Scholar)
Nabin Sedhain (PhD Student 2019-2020)
Kaylen Morgen (Under Graduate Trainee)

Team Members (Lab Members)

Current members (2021-22)

Hayley Milner (Research Professional)
Surender Reddy (PhD Student, Fall-2021)
Calynn and Klelly (Under Graduate Trainee)

Team Members

Dr. Phillip M Roberts
Chandler Rowe (Research Professional)
Jordan (MPPPM Student)
Dr. Robert C Kemerait
Dr. John L Snider
Dr. Peng W Chee
Dr. Camp Hand
UGA Field support staff members



Plant viruses in Agroecosystem in Georgia

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