Southwest 2019 Potato (*Solanum*) Collecting Trip Report

Whole range *Solanum jamesii* DNA survey, and resampling & exploring novel sites including *Solanum fendleri*.
March, August, September, November 2019

Collection prefix = BAM 393 and UWUO (394-407) for multiple collectors from USDA, Wisconsin, Utah, and Ohio. PI numbers 689927, 691559-691571.

Participants: John (JB = USDA/ARS) and Ingrid (IB) Bamberg, Alfonso del Rio (AdR), Charles "Chico" Fernandez (CF), Max Martin (MM) from the genebank; Lisbeth Louderback (LL), Bruce Pavlik (BP), Blake Vernon (BV), Peter Yaworsky (PY), Kari Gillen from University of Utah; David Kinder (DK), Michael Eagon (ME) from Northern Ohio University; Lydia Pyne from Archaeology Magazine, Lindsey Smith (LS) from Chimney Rock National Monument, Zach Cohen (ZC) from University of Wisconsin for September entomology follow-up trip. Full participant affiliation details available on GRIN linked to each collection PI.

1. General Goals, Outcomes, and Research-related Observations:

March 9-11th. Explorations were made on road to Mt. Lemmon near Tucson and around Portal/Paradise AZ where BAM 393 = 689927 jam was collected. Full collection report can be accessed in GRIN by accession search on 689927. In brief: potato collecting has been done in August and September. In 2018, we found a robust population at Sunny Flat Campground near Portal, AZ. In March of 2019, IB and JB were in Tucson on other business, so sought to see how the plants looked during the off season, and how feasible scouting might be. JB first drove to Mt. Lemmon on March 9th, looking at sites known to have abundant *fendleri*. At lower elevations, ground was bare and even some green herbs. But no vestiges of fen could be found. Could not drive to trailheads at top of Mt. Lemmon because much snow at that elevation and ski run open. At this location it appears that plants present in the summer were no longer recognizable. But where accessible, scouting for suitable habitat might be worthwhile. Particularly, for the first time we realized that one might scout micro-habitats with the most winter snow, since that would logically translate to good soil moisture in the spring. On March 11th JB and IB explored Portal area. Large, dried-up brown plants at bridge near Sunny Flat Camp were easily found, although, of course, not nearly as showy as when green in the summer six months earlier. We explored a SEINet report of jam at a new site at the end of Southfork road and easily found many large dead plants, and collected many large tubers. As on Mt. Lemmon, even if plants and tubers could not be found at new sites, being on site likely allows better scouting of particular spots with most favorable habitat to target for exploration in the summer. It occurred to us that the timing of frost and snow might determine if plants were detectable in the early spring. That is, a hard frost on green plants would flatten them, and snow cover would keep them wet and likely to rot away, but when there was no frost before the plants dried up and no snow, their brown stems might stay dry and intact. Such dried plants were, in fact, to be easily observed in November of this same year near Cuba, NM (see below).

August 18-29th. This expedition had multiple objectives. First, we sought to explore and collect new germplasm for the genebank. At the same time, we sought to survey the entire *jamesii* range at 12 pre-determined random sites for precise DNA samples. This latter objective was the first year of a joint research project with University of Utah and Northern Ohio University collaborators aimed at relating distribution of genetic diversity of jam with archeology—that is, evidence of ancient human habitation, jam transport and selection. A second set of 12 sites will be selected for DNA sampling in 2020. A third objective was to intentionally collect mother tubers. These tubers which have already produced a plant are, of course, available before the current-season crop of tubers have matured, and are therefore collectable any time when plants are observed to show a mother tuber's location. But mother tubers are usually not collected because they are

considered “spent” and not able to grow a new plant, despite often being firm and apparently viable. We brought these back to the genebank to see if they could be made to produce a second plant, thus be practical propagules for germplasm collection. DK and ME observed robust jam populations at Chaco Canyon and Bandelier National Monument on this trip, but did not collect germplasm.

For the first time, the expedition was conducted with multiple teams: The Blue team led by Utah participants were responsible for sampling northern AZ and southern UT target sites. Red team led by Wisconsin participants were responsible for southern NM and northwest TX sites. Purple team led by USDA participants covered sites in northern NM and southwestern CO (see map in picture section following).

Several “firsts” were accomplished. We found the first germplasm in the Abiquiu area, the first jam in the Lincoln NF around Cloudcroft—which is also first jam co-located with fen in this area, another rare site in CO and the first at Chimney Rock Nat. Mon, and the first jam between 53 and 40 in the Cibola NF. We also became aware of, and made contact with landowner Chris Roll for jam at the lowest confirmed elevation near Willcox, AZ (see March report for full details).

Because this year’s trip aimed to cover so much territory, it particularly served to reveal many sites that looked promising for future exploration but for which there was no time to search in the current expedition.

This year the live plants we collected established exceptionally well at the genebank-- over 95%. We do not know if collecting earlier in the season was the reason. In recent years we have collected a month later in September because of the advantage of being able to collect mature fruits and tubers.

Some of the participants had many years of experience, others had none. We like to think experience is important for recognizing the often obscure and rare plants, but they were first spotted by BV at Salitre Picnic and by ME at Chimney Rock.

September 22. Zach Cohen of UW entomology went to sites we identified in August. In particular, he visited Guardrail site near Cuba and met longtime local rancher Mr. Weise, who showed him a new site on his farm about 5 miles S of Cuba where ZC collected 3 mother tubers.

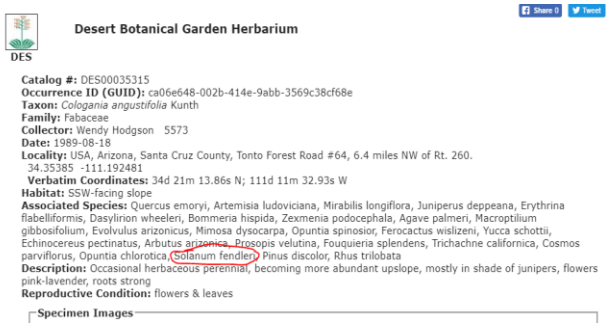
November 1. While in area for harvesting plots at New Mexico State University agricultural farm near Farmington, New Mexico, JB and IB scouted for suitable habitats between ABQ and Farmington and observed plants at Cuba Fairgrounds and Guardrail site discovered two months earlier. CR11 that runs parallel to 550 S from Cuba did not have particularly good habitat or access. On the other hand, Rt 290 NE of Ponderosa in the Santa Fe NF looked very good. We did not explore the Jemez river valley along Rt 4, but it should also be good habitat and elevation. More generally, there are no germplasm collections in the southern Santa Fe NF, although we have long known about herbspecs from Bandelier National Monument.

2. Preparations:

Target sites for DNA collection were selected in early spring by UT participants. JB used these and selected alternate sites to plan 3-team expedition plan. This plan also included exploration of new promising habitats for germplasm collecting, especially in under-represented regions. LL, BP and AdR made extensive preparations for DNA sampling methods and supplies which will not be detailed here. Garmin GPSs borrowed from PEO, and uploaded tracks, waypoints and notes from DeLorme Topo10 and GoogleEarth. We reviewed all known potato sightings and herbarium records (particularly from SEINET) and also spent much time using maps to scout and list promising new sites to explore before the trip. As in previous years, GoogleEarth aerial photos were very helpful in showing the exact ground cover, aspect (steep and shaded NE preferred), elevation, and soil moisture potential of the micro-locations which are the small niches in which potatoes are most likely to appear within a general area. The most promising sites that are most rapidly accessible (ideally on paved roads) near the general trip loop have to take priority in order to efficiently spend travel time. We had searched collection records of non-potato species for mention of potato as associated taxa. Only one site above Kohl's ranch E of Payson mentioned a new site for fen (see section detailing possible future collecting).

Navigation. We had GPS tracking on Topo10 canned maps so not dependent on internet.

Personnel. Some division of labor made collecting more efficient: For Purple team, for example, JB driving; IB taking detailed collecting notes and ideas from JB's dictation; CF collecting tubers, carrying and indexing tubers, fruit and plants, extracting seeds and establishing plants at USPG. All took photos.



Desert Botanical Garden Herbarium

DES

Catalog #: DES00035315
Occurrence ID (GUID): ca06e648-002b-414e-9abb-3569c38cf68e
Taxon: *Cologania angustifolia* Kunth
Family: Fabaceae
Collector: Wendy Hodgson 5573
Date: 1989-08-18
Locality: USA, Arizona, Santa Cruz County, Tonto Forest Road #64, 6.4 miles NW of Rt. 260.
34.35385 -111.192481
Verbatim Coordinates: 34d 21m 13.86s N; 111d 11m 32.93s W
Habitat: SSW-facing slope
Associated Species: Quercus emoryi, Artemisia ludoviciana, Mirabilis longiflora, Juniperus deppeana, Erythrina flabelliformis, Dasylirion wheeleri, Bommeria hispida, Zexmenia podocephala, Agave palmeri, Macroptilium gibbosifolium, Evolvulus arizonicus, Mimosa dysocarpa, Opuntia spinosior, Ferocactus wislizeni, Yucca schottii, Echinocereus pectinatus, Arbutus arizonica, Prosopis velutina, Fouquieria splendens, Trichachne californica, Cosmos parviflorus, Opuntia chlorotica, Solanum fendleri, Pinus discolor, Rhus trilobata
Description: Occasional herbaceous perennial, becoming more abundant upslope, mostly in shade of junipers, flowers pink-lavender, roots strong
Reproductive Condition: flowers & leaves

Specimen Images

Here are the herbspec sites not previously visited by us from SEINet, and shown as red flags on the maps in Section 10 of this document…

Table 1.

Map pin P code numbers	Lat	Lon
1	35.76372	-106.35424
2	35.75751	-106.32883
3	35.7844	-106.27448
4	35.78505	-106.28424
5	35.82533	-106.32602
6	36.328	-105.5282
7	36.328	-105.6
8	36.5778	-105.7853
9	36.4624	-105.945
10	36.2771	-106.3903
11	36.362	-106.4186
12	36.2069	-106.58062
13	36.70897	-107.30724
14	37.02361	-107.3625
15	37.00889	-107.40917
17	37.0975	-107.65028
18	35.215	-108.14

3. Logistics:

Travel was by air to Albuquerque, renting vehicles from Enterprise. Purple Team, for example, used a Chevy Tahoe driving a total of 1707 miles. Red team drove 1640 miles. No backpacking, camping or major hiking was done on this trip.

4. Germplasm:

Wild potato *S. jamesii* and *S. fendleri* (*stoloniferum* in GRIN) were collected as 13 samples. Samples were given temporary codes during the expedition, and assigned UWUO collector codes and PI numbers later (see Tables for details). DNA samples for research were collected from 12 sites. Blue team did not collect germplasm.

5. Deposit of records, germplasm and files:

US Potato Genebank, 4312 Hwy 42, Sturgeon Bay, WI, 54235. 920-743-5406. john.bamberg@ars.usda.gov. Query OWUO collector prefix or individual PI numbers in GRIN. Detailed trip log, GPS track and Waypoints files, and additional photos and miscellaneous notes are available from JB at USPG.

6. Trip expenses:

We thank K. Williams of PEO for $7.5K funding. Other travel support was supplied by UT collaborators' grant, project funds, and private funds (IB).

7. Daily Itinerary and Collections Abstract:

PURPLE TEAM

Aug 19th Monday. Participants of all teams who had flown to ABQ the day before met at Magdalena, NM on Aug 19th to train for uniform leaf sample collection for DNA at the familiar roadside picnic jam collection site about 12 miles W of Magdalena town (e.g., see PI 686449). Met for lunch and briefing at "Magdalena Café", registered at "The Hall" hotel. All afternoon was spent at the roadside picnic site (between mile number 100 and 101 on Rt 60, N side of road). Plants abundant on both sides of road in ditch and around picnic tables, largest 6-8 inches, dozens flowering, some with fruit starting to develop. Did not cross fence. While others returned to Magdalena, IB and JB drove W on 60 to scout Baldwin pasture site near Datil at sunset (see PI 686447) for collecting Tuesday. Confirmed many plants present, so returned to Magdalena lodging after supper at Datil.

Aug 20th Tuesday. Met all participants at Datil at 10AM and proceed to Baldwin site. **Collection # Baldwin**. Depart about 1 PM, with teams splitting up. Individual team narratives follow…

Purple team returns E on 60 to Socorro, N on 25 to ABQ and W on 40 to Grants via Rt 6 shortcut. Down 53 to Zuni-Acoma trailhead. No plants seen under single tree as observed in 2018. To El Morro National Monument, where no plants could be found at campsite as previously (see PI 612453). W to Ramah town (looked around museum) for supper at Stagecoach Inn. Back to Ancient Way cabins to lodge.

Aug 21st Wednesday. Found abundant plants, more broadly distributed, larger and sometimes flowering all around grounds of Ancient Way Café and cabins, and S to water tank, a few as before (see PI 686439) across the highway. Collected mother tubers. Return to Grants via 53. Breakfast at El Caficito café. W on 40 to exit 53 to Rt 612 S to Bluewater Lake (paved) and past S on good gravel to previous herbspec report [P18]. Looked possible but no plants found. Return N to camp/picnic site along W side of Bluewater Creek. **Collection # Salitre Picnic.** Return E on 40 toward ABQ with quick lunch at McDonalds and then on 25 past Santa Fe and to Glorieta Camp [686446] for leaf samples only. Plants common, but not nearly as abundant as in 2017. Back to Bernalillo and Range Café for supper. N to Holiday Inn Express on 550.

Aug 22nd Thursday. Purple team member BV joins DK and ME to go to Chaco Canyon. IB and JB proceed N on 550 to scout sites around Cuba. Stop at guardrail to discover new jam site but plan germplasm collection for final days of trip when we return to ABQ. To Cuba and W on 197 to previous collection site of PI 595788 and PI 612452 but found nothing. Looked along 197 at several spots beyond and on return to Cuba. W on 126 (paved) from Cuba into Santa Fe NF to mile 6. Looked in steep canyon along S side of road. Looked good but found nothing except some plants that looked like carrots, rare in this area. Proceed farther to FR533 to look. Return to Cuba and to Fair and Rodeo grounds. **Collection # Fairgrounds.** N to Apache Nugget travel center where we discovered a CPB crawling around inside the vehicle (must have been on plants at Cuba Fairgrounds site). Bottled for entomology collaborators at UW. To Counsellors and N on 379 for unsuccessful attempt to re-find jam at site of 620876. Return and continue on 550 to

Bloomfield and Aztec, Bondad, then E on 318 to near Ignatio, CO for SEINet site [P17]. Looked possible, but very dry. To Durango via 172 to meet DK, ME, BV and supper at Nayarit Mexican restaurant. Lodge at Super 8 motel.

Aug 23rd Friday. BV joins Purple team to explore around Navajo Lake. Breakfast at Doughworks. Return to site of 603054, near Haystack Mountain at farm owned by Carol Thiele. Very dry and no plants found. Lunch at Arboles cafe. To SEINet herbspec site [P15] on W shore of Navajo Lake. Coordinates are for parking lot. Habitat around lake shore looked possible but found nothing. Proceeded up 151 to where one can cross N finger of lake to Rt. 500 and back down to N shore site of SEINet herbspec site [P14]. Floodplain with willows and soft gray sand looked very possible, but found no plants. Return on 151 to 172 intersection at Ignacio at event center. Looked from vehicle around horse buildings. Looked very good as does a lot of area around Ignacio town. Return to Durango airport to drop off BV for return to UT and pick up CF to join Purple team. Supper at Serious Texas Barbeque in Durango and lodge at Super 8 motel.

Aug 24th Saturday. Lone Spur Café, Starbucks, Speedway gas. Then E to meet DK and ME at top of Chimney Rock National Monument and also site archeological manager Lindsey Smith. DK had observed jam at Chimney Road in previous years. **Collection # Chimney Rock**. Also looked at likely spots along road back to Rt 151. Return N on 151 and E on 160 to Pagosa Springs and coffee stop at Boulder Coffee. S on 84 to 64 W to where 64 crosses La Jara Creek at cite of SEINet herbspec [P13]. Under bridge and among willows in sandy bottoms. Looked very good. Back to 64 and S to Chama to lodge at Branding Iron and Fosters for supper.

Aug 25th Sunday. Fina's Diner for breakfast, then more coffee at Rio Chama Espresso and planning. S to outskirts of Chama at Chama Land and Cattle Co. driveway. Looked good. Went back and asked El Mason Lodge if we could look along river bottoms on their property. Looked very good. On 64 S on way to Abiquiu at Echo Amphitheater. Looked good but dry. To Abiquiu and Bode's General Merchandise gas station for supplies. Looked around parking lot below among cottonwoods. To Georgia O'Keefe museum and S on 187 to crossing of creek. Lowlands among cottonwoods and grass. Then back to around Post Office grounds. All looked good. To 84 E and 68 N to Racho de Taos and 518 S to Rio Chiquito road. Rough gravel prevented getting quite to herbspec site [P6] at FR473 at Drake Canyon, but looked at several likely spots along the way that all looked very good. Back to Rancho de Taos to Sagebrush Inn to lodge with in-house nachos supper.

Aug 26th Monday. Hotel breakfast. To Taos and Elevation Coffee and Ms. Quick Stop to get oil change. Continue 64 over Rio Grande and to SEINet site [P8]. Rough gravel road to this is unlikely dry open grassland. Perhaps could support jam since some solana herbs present, but we found no potatoes. Then W to Tres Piedras at 285 jct and S. Could not find good way to get to SEINet site [P9] in Canada de los Comanches, although only about 2 air miles W of 285. Instead went S to Ojo Caliente river fork and N on 111 to La Madera, looking at some spots with iconic J/P habitat. Sites around La Madera town looked good. Also, W on 519 at river, and continue N on 519 to hairpin curves. **Collection # Culvert**. Since we found plants at this site, more exploration in the area is warranted. For example, 111 and 519 are paved up their respective valleys to appropriate elevations. Back to 111 and W on 554 to El Rito. Around this town looked like good habitat and at cemetery. Another time should go SE on Placitas road 215/218

and all through farming valley below El Rito at ~6500 ft. Back to Abiquiu on 554 and stop at Bode's for food. Check NE exposure of cliff at river on 84. Site of SEINet herbspec [P11] could not be accessed and seemed too high and dry. To Reservoir, across dam and down east side to river. Looked very good at picnic area and N-facing cliff. Continue on 96 W to lookout point. Another time should go down 196 through green Cañones valley at good elevation about 6500 ft. Also, could go S from Coyote where road crosses Coyote Canyon at ~7300 ft. Not enough daylight left so we continue W on 96 to Coyote near SEINet herbspec [P12]. **Collection Coyote**. Then 96 W and S to 550 and S to Cuba. Lodge at Frontier Motel and supper at El Bruno's.

Aug 27th Tuesday. Picnic breakfast on motel grounds, then to McDonald's. To Guardrail site S of Cuba. **Collection # Guardrail**. Met local rancher Mr. Weise who said in early days ground froze hard and deep in this area, enough to freeze buried water pipes. Met Red Team members at Sleep Inn Airport ABQ. Walked to Applebee's for lunch. Exchange experiences and other ideas in breakfast room in afternoon (Red Team trip report follows). Washed and gassed up vehicles. Looked for boxes in dumpsters to carry back the live plants. Supper at 377 Brewery and pack for trip home.

Aug 28th Wednesday. Return vehicles and fly home.

RED TEAM

Monday August 19 See Purple Team narrative

Tuesday August 20

After lunch, Red Group departed to collecting site *Iron Creek*. We stopped at the Railroad Canyon Campground (32.907950, -107.817052) across on top of the creek; we found a few *S. fendleri* plants, they were either small or medium size. In addition, we found some healthy plants across the creek at the *Iron Creek Campground* (32.9092, -107.8058) but no *jamesii* was found despite following descriptions of the collecting report. The creek showed water running because of recent rain in the area. On our way out, we stopped at Emory Pass (32.910574, -107.764264) where we also found some fen in good shape, flowering was starting in some.

We spent the night at the Quality Inn at Silver City. Dinner was at Toad Brewery.

Wednesday August 21

We drove to collecting site listed as *Mile 17 on 90*. The area looked very dry and we looked for plants all over, we stopped 0.7 miles before the mile mark and explored to the site. We did not find any plants. David Kinder and his student Michael Eagon took part of the exploration.

Since plan to go to explore site at Chris Roll's land was canceled, we decided to drive to Sierra Vista, AZ to gain a day in the schedule and drive to Parker Lake that day. However, since heavy rains and thunderstorms prevented us from continuing to Parker Lake, we decided to turn around due to dangerous driving conditions. Instead of coming back to Sierra Vista for lodging, we found good and affordable accommodations at the Sonoita Inn in Sonoita, AZ. We had dinner at the Copper Brothel Brewery that was within walking distance of the hotel.

Thursday August 22

Early in the morning we drove from Sonoita to population site indicated as *Ida Canyon*. We first stopped at *Parker Canyon* (site of PI 689401) and looked for plants, but did not find any. Then we went to *Ida Canyon*, the site of PI 669605. The habitat there can be described as a shady area with oaks and cottonwood. We found a large number of small to medium size jam plants distributed in a large area in a sort of stream bed with layers of leaf mulch. We also found spots of plants on the sides of the trail. The plants looked healthy; probably there were a few hundred of them all along the range. Tissue was collected for DNA. Most of the quadrants but one had the 8 plants required to be collected. Return early afternoon as rain started, we encountered flash floods, hail storms and very dangerous driving conditions coming back. We stopped for a few minutes to wait for the storm to slow down since visibility with the rain was almost zero. The storms and rains continued the rest of the afternoon so we did not pursue activities. We drove to Willcox, AZ and spent the night at the Days Inn.

Friday August 23

Left Willcox, AZ and drove to Portal, AZ to collect at the site at *Cave Creek (Portal)* near Sunny Flat camp. This site corresponded to PI 689431 (for description of the habitat). We found many jam plants on both sides of the road (Forest Service Road 42) and under the bridge. Plants were in good shape and were either small or medium size. Probably there were a couple hundred plants in that area. Plant tissue was collected for DNA. We left Portal for El Paso, TX in early afternoon. Lodging at La Quinta.

Saturday, August 24

Explored site at Smuggler Pass (see PI 603053). The area looked very dry and we did not find plants. After phone conversation with JB, group decided to skip long trip down to W Texas near Fort Davis, instead explore target sites in the Lincoln NF of NM at Weed, Cloudcroft, and Monjeau Lookout.

We drove to the SEINet jam herbspec site for near Weed (M.A. Baker 14770 [2002]) but we could not reach the place because the road took us to a private access point blocked by a locked fence. We instead explored nearby sites with promising habitat. We stopped in a place by Bear Canyon Road out of NM-24 close to the intersection with NM-130. At the entrance there was a sign indicating Mary White Camp Road but also was called Bear Canyon Road. We did not drive to the campsite, but stopped about 0.1 mile beyond the intersection with NM-24 on the NW side. We found jam and fen plants. The habitat has Ponderosa pines, grass and mulch. It is close to a dry creek. The plants of jam were spread out in a range of ~25m and they were found in the open, among the grass and under the trees. The plants were small and medium size, looking healthy. We estimated about ~50 plants of jam in the collecting range. The plants of fen shared the same environment; some of them were in close vicinity to jam plants. Most of the plants were healthy and small, but we found one plant with fruits. We estimated ~100 fen plants. We collected tissue for DNA for jam and germplasm for both species. Mary White Canyon has the coordinates LAT 32º50.9670'N and LON 105º32.5116'W, elevation 6872. **Collections # Mary White Canyon – both fen and jam**.

We stopped at Cloudcroft for lunch and then went to site *Monjeau Lookout Peak* by taking NM-48 and then NM-117 from Ruidoso, NM. We found a large number of fen plants, probably thousands. The plants were in different stages of development. They looked very healthy and displayed vigorous growth. Many of them were flowering and we observed large clusters of plants on the sides of the trails to the campsites. We suspected that, in general, these plants will set fruits in about 3-5 weeks. This site corresponds to previous collection see 458413 and 564045. Coordinates taken were 33º25.8910' x -105º43.861', elevation 9551. **Collection # Monjeau Lookout Peak**.

We decided to drive to Carrizozo instead of coming back to Ruidoso. Lodging was at the Carrizozo Inn at Carrizozo, NM. We had dinner and breakfast at the Four Winds Restaurant across the hotel.

Sunday August 25

Left Carrizozo at 8 AM to explore sites indicated as *Corona, Tajique and Gallinas* in the Red Group collecting assignments. We stopped at the sites, but we did not find plants.

We looked at promising sites near Corona in Cibolo NF. **Collection # Red Cloud Campground.** Near Corona on road to Gallinas Peak. Found jam plants dispersed along the two sides of a primitive road leading to campsites; about 50 m from intersection with CR A023. The plants were small and very young growing in mulch, junipers and a few Ponderosa pines. The plants spread out from a few meters of both sides of the primitive road to about 25m. There were hundreds of plants and we were able to set up quadrants to collect tissue for DNA. The coordinates of this site were 34º11.136' x -105º43.362', elevation 7198. There is a windmill across CR A023 close to the site.

We drove to Edgewood, NM and lodged at the Comfort Inn & Suites. We had dinner at the Pizza Barn.

Monday August 26

We visited site Dove Valley on 40 E of Albuquerque (see PI 686450). **Collection # Dove Valley.** We found numerous jam plants at the open space at the intersection of Dove Valley Road and Towhee Trail. We collected tissue for DNA. The plants looked good; small, medium and large plants were narrowly distributed in the open but protected by tall grass. We observed additional ones on the other side of the fence.

After collecting at Dove Valley, we drove to Sandia Crest to explore. No potatoes have been reported here. We had different stops on the way to the peak but we did not find plants of fen or jam. The place looked good, however, and it may be worthwhile to look around more in the future. Coordinates 35.1723 x -106.3761.

We returned to Albuquerque for the next two nights.

Tuesday August 27

Since we completed the DNA collection targets ahead of time, we decided to explore sites near Placitas, NM following NM-165 E from Placitas on the way to Sandia Cave and Palomas Peak. There was a stream with water running so many places showed good levels of moisture. We found many places with habitat potential for both species, although there is no credible report of fen this far N to our knowledge. This is an area close to ABQ and easy to get to. On E side of Sandia mountains along waterways and 6000-7500 elevation should be very good for jam, so why has only 686450 been reported? We agreed that this is another area to look in the future with more time. Coordinates 35º15.265 x -106º24.427.

Table 2. List of materials collected and narratives

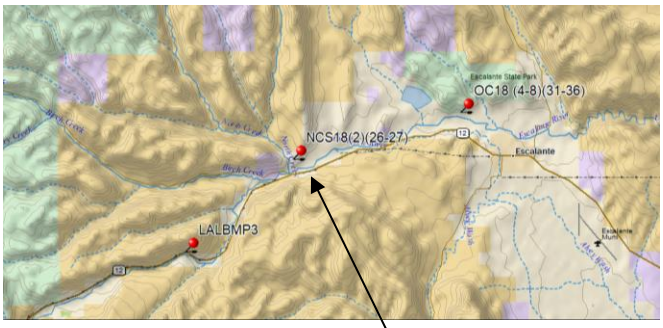
Full narratives with location coordinates, habitat and plant descriptions, collection details and disposition are available in GRIN by query on individual PI number. See PI 689927 for full log of March trip and collection. Also access GRIN for updates and eventual evaluation data.

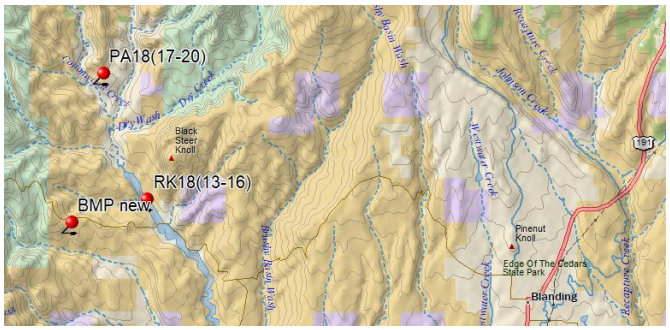
Place	sp.	Date	UWUO	PI	Plants Collected	Mother tubers collected	Fruits collected	Seeds collected	State	Fall 2019 Seed Increase number
Baldwin	jam	Aug 20	394	691559	20	29			New Mexico	FA19 048
Salitre Picnic #2	jam	Aug 21	395	691560	11				New Mexico	FA19 049
Ancient Way	jam	Aug 21	396	691561		7			New Mexico	FA19 050
Fairgrounds	jam	Aug 22	397	691562	15	14			New Mexico	FA19 051
Chimney Rock	jam	Aug 24	398	691563	16	5			Colorado	FA19 052
Mary White Canyon Rd #1	jam	Aug 24	399	691564	3	3			New Mexico	FA19 053
Mary White Canyon Rd #2	fen	Aug 24	400	691565	3	1	1	30	New Mexico	FA19 054
Monjeau Lookout	fen	Aug 24	401	691566	7		24	66	New Mexico	FA19 055
Red Cloud	jam	Aug 25	402	691567	6				New Mexico	FA19 056
Culvert	jam	Aug 26	403	691568	14	6			New Mexico	FA19 057
Coyote	jam	Aug 26	404	691569	3	3			New Mexico	FA19 058
Dove Valley	jam	Aug 26	405	691570	6	9			New Mexico	FA19 059
Guardrail	jam	Aug 27	406	691571	17	12			New Mexico	FA19 060
Weise Ranch	jam	Sep 22	407	692870		3			New Mexico	

8. Additional and more intensive future exploration possibilities related to this trip

Canyons above La Madera and below El Rito, Tater Canyon in Kaibab above Grand Canyon, above Kohl's Ranch in Tonto Canyon for new fen reported as associated taxa, in Coyote and Cañones valleys below Abiquiu, and appropriate elevations for jam E of Sandia Mountains E of ABQ. Jemez river valley and other appropriate elevations in nearby Santa Fe NF, including Bandelier National Monument where we know abundant jam grows. Zuni Canyon road SW of Grants. Navajo Lake. Lincoln NF fen W of Weed. We know fen is abundant on Mt. Livermore in Davis Mts. of TX, but jam is ephemeral, so more sites need exploration like the blue pins on the map below that we have not visited.

Blue Team identified six sites shown in maps below (near Escalante and Blanding, Utah) where germplasm could be collected.



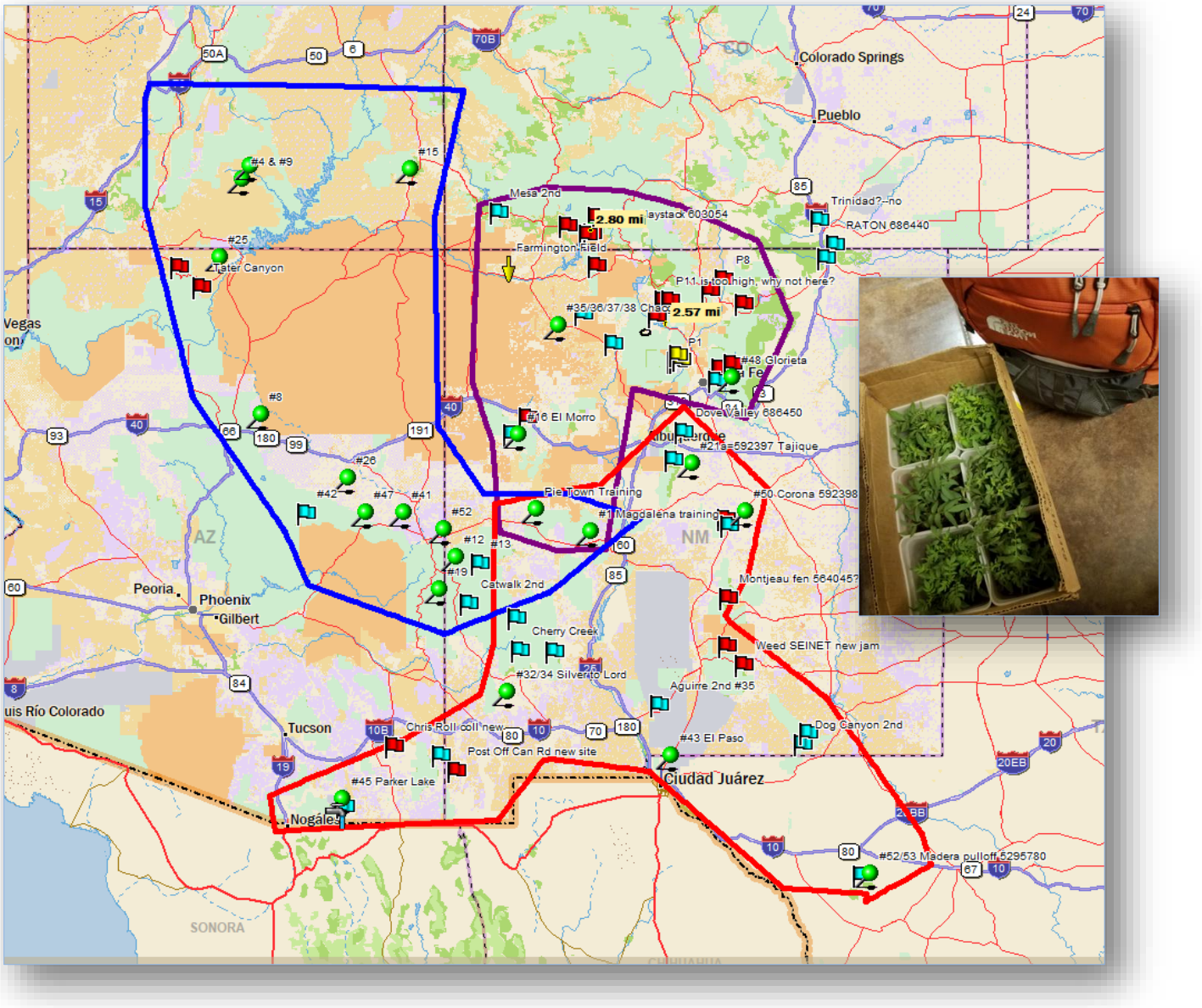


9. Permits

JB obtained NF permit for SW region and NF in CO, also TX state part of El Paso site. LS provided permit on site for Chimney Rock NM. BP obtained permits from USFS and BLM for all teams.

10. Trip map

Participants flew to ABQ and initially met at intersection of three loops in Magdalena for DNA collection training for the Red, Purple and Blue teams.



12. Collection narratives for GRIN.

PI 691559. UWUO 394. *S. jamesii*. United States. New Mexico. Catron County. Cibola National Forest. Near Datil. NW from Datil on 60 about 3.7 miles to dirt road to NE to "Baldwin Station" corrals. Site of Hiler 14 [1921] reported as *S. fendleri*, and *jamesii* 686447. Meadow S of corrals. At WSG 34° 10.922'N x 107° 52.763'W and 7500 ft. Coll August 20, 2019. Very abundant. Widely scattered green tuberling plants mostly 2-6 inches, rarely flowering. Mostly in open grassy meadow in brown soil. Collected 29 broadly dispersed mother tubers.

PI 691560. UWUO 395. *S. jamesii*. United States. New Mexico. Cibola County. Cibola National Forest. Near Thoreau. South from Thoreau past Bluewater lake on 612 to picnic site on W side of road just past the bridge over Bluewater creek near Salitre mesa. Near site of N.L. Riffle 780 [1968]. At WSG 35° 14.089'N x 108° 7.913'W and 7570 ft. Coll August 21, 2019. One small colony of small green plants to about 5 inches. In open grassy slope in brown rocky soil. Collected 11 plants.

PI 691561. UWUO 396. *S. jamesii*. United States. New Mexico. Cibola County. Cibola National Forest. Near El Morro. From Grants S and W on 53 to about one mile E of El Morro National Monument entrance at Ancient Way restaurant and campgrounds. Site of PI 686439. At WSG 35° 2.654'N x 108° 19.190'W and 7300 ft. Coll August 21, 2019. A few plants scattered widely along driveway to store, among cabins, and near water tank. Some in open, small and withered, some around cabins larger and flowering. Collected 7 mother tubers.

PI 691562. UWUO 397. *S. jamesii*. United States. New Mexico. Sandoval County. Near Cuba. From Cuba S on CR 11 about 2 miles to Rodeo road and into fairgrounds to arena. Widely dispersed around arena. At WSG 35° 59.562'N x 106° 58.385'W and 6870 ft. Coll August 22, 2019. Many robust green plants to 12 inches. Colorado potato beetle adults and egg masses present. In shade of fences and under trees in needle mulch and sandy brown soil and among grass. Collected 15 plants and 14 mother tubers.

PI 691563. UWUO 398. *S. jamesii*. United States. Colorado. Archuleta County. Near Chimney Rock National Monument near Piedra. Walking SW from parking lot at crest. At WSG 37° 11.347'N x -107° 18.761'W and 7373 ft. Coll August 24, 2019. Over 50 small plants to 4 inches in one place. Some withering. Among rocks and dry rocky and sandy soil, mostly open, often without much mulch, S-facing slope. Collected 16 plants and 5 mother tubers.

PI 691564. UWUO 399. *S. jamesii*. United States. New Mexico. Otero County. Lincoln National Forest. Near Mayhill. From Mayhill SW on 130 about 5.3 miles then 0.5 miles S on Bear Canyon Rd on the way to Camp Mary White. At WSG 32° 50.967'N x 105° 32.512'W and 6965 ft. Coll August 24, 2019. About 50 small green healthy plants. With *fendleri* also present. Ponderosa pines, grass and mulch, close to creek (dry). Collected 3 plants and 3 mother tubers.

PI 691565. UWUO 400. *S. fendleri*. United States. New Mexico. Otero County. Lincoln National Forest. Near Mayhill. From Mayhill SW on 130 about 5.3 miles then 0.5 miles S on Bear Canyon Rd on the way to Camp Mary White. At WSG 32° 50.967'N x 105° 32.512'W and 6965 ft. Coll August 24, 2019. About 100 small green healthy plants with *jamesii* also present. Ponderosa pines, grass and mulch, close to creek (dry). Collected 3 plants, 1 mother tuber, and 1 fruit yielding 30 seeds.

PI 691566. UWUO 401. *S. fendleri*. United States. New Mexico. Lincoln County. Lincoln National Forest. Near Ruidoso. From Ruidos N on 48 and W on 532 then N on 117 to top of Monjeau Peak, site of 458413 and 564045. At WSG 33° 25.8910’N x 105° 43.861'W and 9551 ft. Coll August 24, 2019. Thousands of widely spread green healthy plants, many flowering. High open grassy peak. Collected 7 plants, 24 fruit yielding 66 seeds.

PI 691567. UWUO 402. *S. jamesii*. United States. New Mexico. Lincoln County. Cibola National Forest. Near Corona. From Corona SW on 54 for 8 miles then 5 miles W on A023 to Red Cloud Campground. Both sides of primitive road leading to campsites, across from windmill. At WSG 34° 11.136'N x 105° 43.362'W and 7198 ft. Coll August 25, 2019. Hundreds of plants, small and young. Growing in mulch, junipers and a few Ponderosa pines. Collected 7 plants, 24 fruit yielding 66 seeds.

PI 691568. UWUO 403. *S. jamesii*. United States. New Mexico. Taos County. Carson National Forest. Near LaMadera. From LaMadera Post Office 1.8 miles N on 519. At pass over creek at hairpin curve, N side N end of huge culvert. At WSG 36° 24.182'N x 106° 1.476'W and 6670 ft. Coll August 26, 2019. Only one small group of small plants. Dry gravelly soil of steep N facing road grade in red-brown soil. Collected 14 plants and 6 mother tubers.

PI 691569. UWUO 404. *S. jamesii*. United States. New Mexico. Rio Arriba County. Santa Fe National Forest. Near Coyote town. Just W of 96 bridge where it crosses Coyote Creek on S roadside ditch. At WSG 36° 09.922' N x 106° 36.867' W and 6721 ft. Coll August 26, 2019. Only one small group of plants up to 8 inches tall. In grassy roadside among scrub trees. Collected 3 plants and 3 mother tubers.

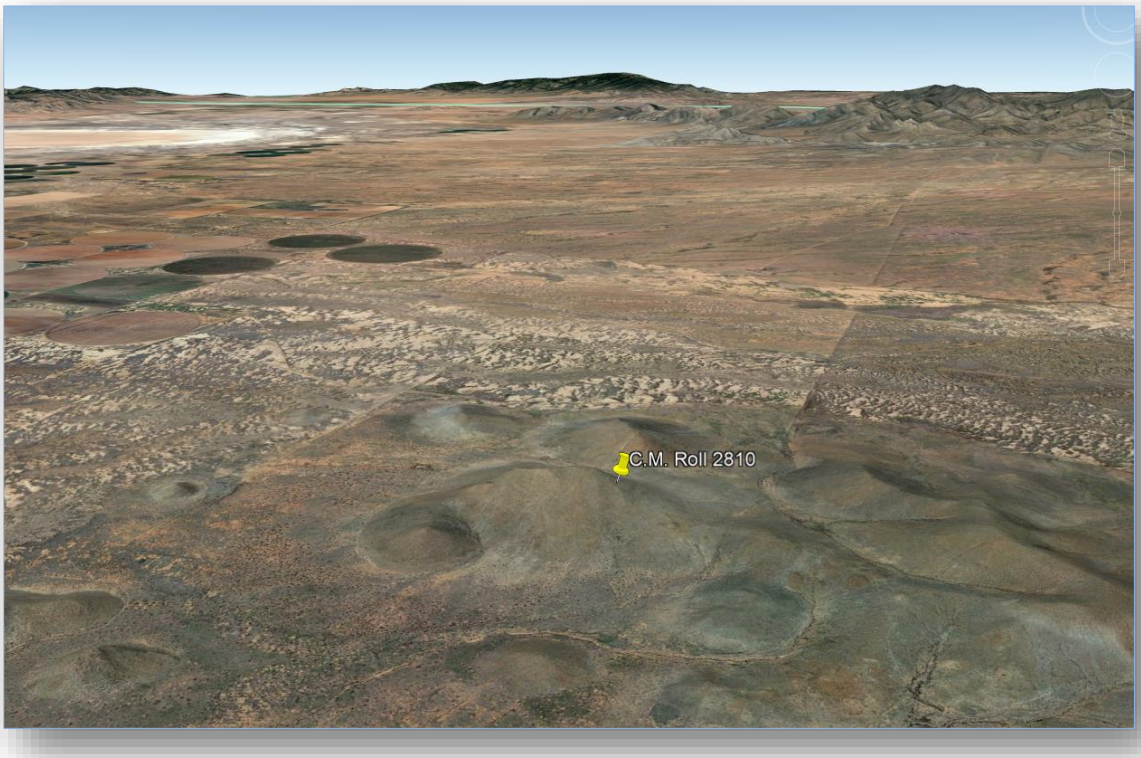
PI 691570. UWUO 405. *S. jamesii*. United States. New Mexico. Bernalillo County. Cibola National Forest. Near Albuquerque. E from Albuquerque on 40 about 25 miles, then frontage road 66 E and S on 217 about 2 miles and W on Dove Valley road. At NE corner of dead end of Dove Valley road and private drive. Most within 30 ft of E edge of private road to N. Site of herbspec M.A. Tafoya [1977] and PI 686450. At WSG 35° 03.804'N x 106° 16.063'W and 6950 ft. Coll August 26, 2019. Many plants widespread, green and healthy of various sizes. In open dry brown sandy soil among grass. Collected 6 live plants and 10 mother tubers.

PI 691571. UWUO 406. *S. jamesii*. United States. New Mexico. Sandoval County. Near Cuba. From Cuba on 550 S about 4.5 miles. In ditch at NW side of stone outcroppings to the E near N end of guardrail on E side of road. At WSG 35° 57.893'N x 106° 59.443'W and 6784 ft. Coll August 27, 2019. Many green plants up to 10" with some flowering. CPB present with some feeding. In grassy roadside among scrub and rabbit brush and sage. Collected 17 plants and 12 mother tubers.

PI 692870. UWUO 407. *S. jamesii*. United States. New Mexico. Sandoval County. Near Cuba. From Cuba at 197 intersection S on 550 for 5.0 miles to farm road to E. About 100 ft E to water pond. At WSG 35° 56.702'N x -106° 59.004'W and 6784 ft. Coll September 22, 2019. Two plants, isolated, small, flowering. In recently disturbed soil from ponds dug for livestock water. Collected 3 mother tubers.

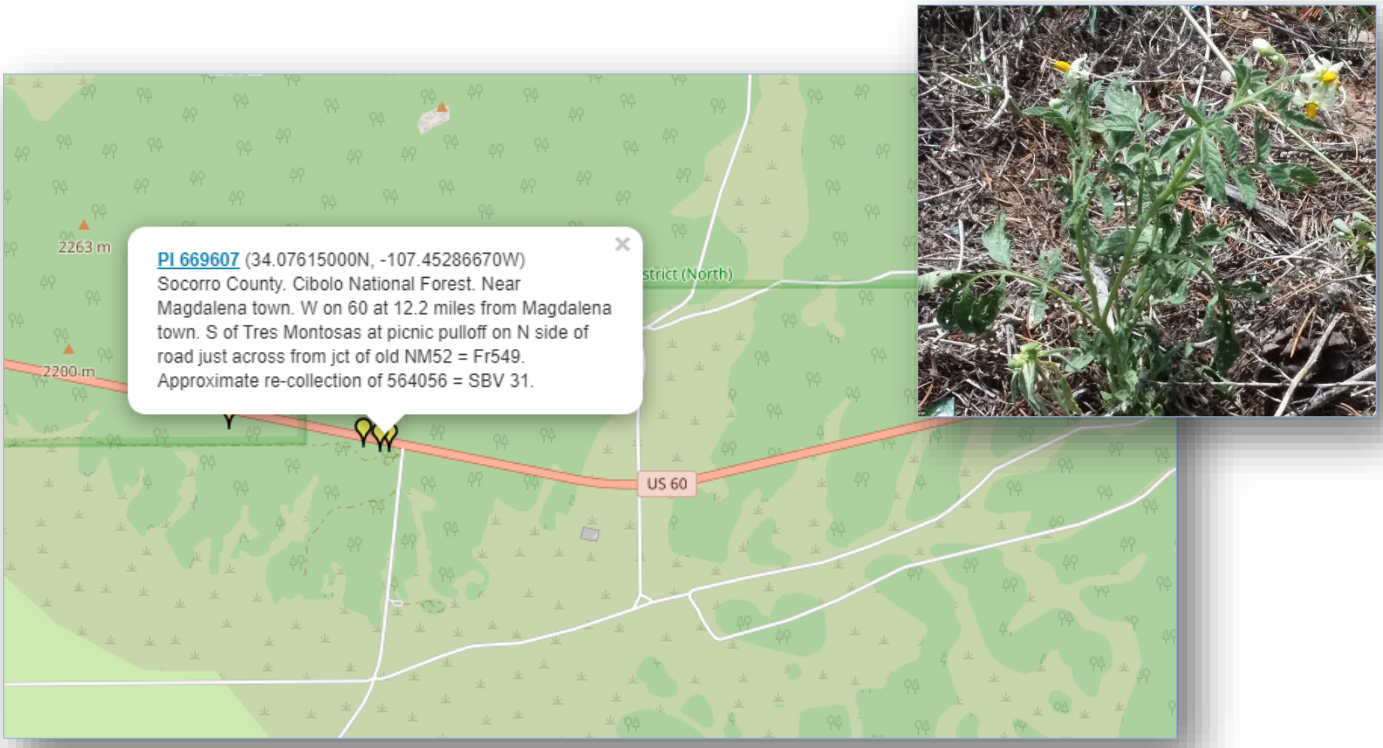
11. Collection site visuals of locations, habitats, and plants
GPS tracks are for JB. Additional trip pictures are archived at the genebank

March trip. Full collection report with visuals can be accessed in GRIN by accession search on 689927. Here (→) is a photo taken by Mr. Chris Roll of jam on his land near Willcox in the summer. We would like to eventually collect this site as the lowest confirmed jam germplasm known.



August trip. Purple team…Magdalena (all teams together here)

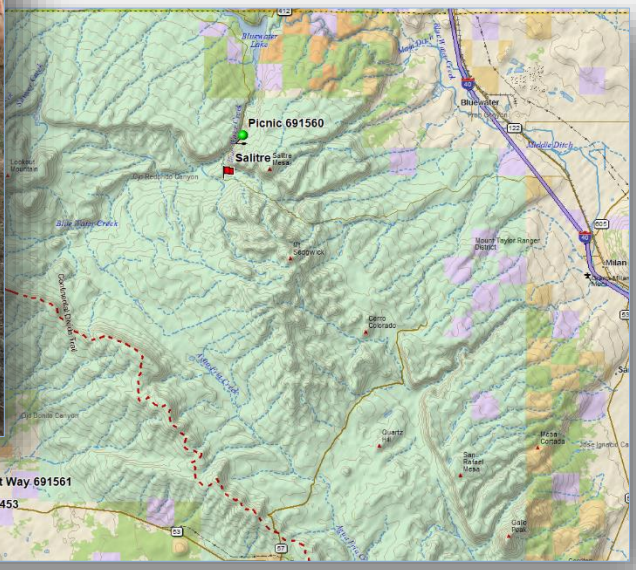
See collecting report for PI 669607 and 686449 for more visuals.



Baldwin (all teams together here)

See collecting report for PI 686447 for more visuals.

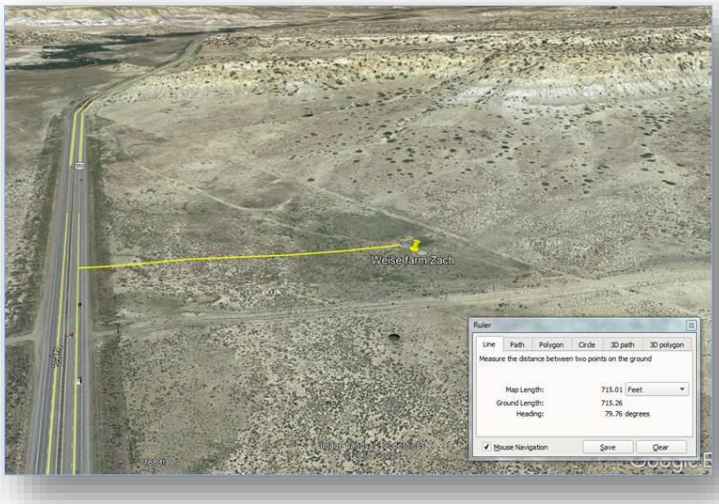
Ancient Way. BV and JB shown. See collecting report for PI 686439 for more visuals.



Salitre Picnic. (see map on previous Ancient Way page for location)

Glorieta Bible Camp. DNA collection only. See collecting report for pervious germplasm PI 686446 for more info and visuals. BV shown.

Guardrail and Weise Ranch. JB, Mr. Weise, and IB shown. Aerial map of Weise Ranch collection.

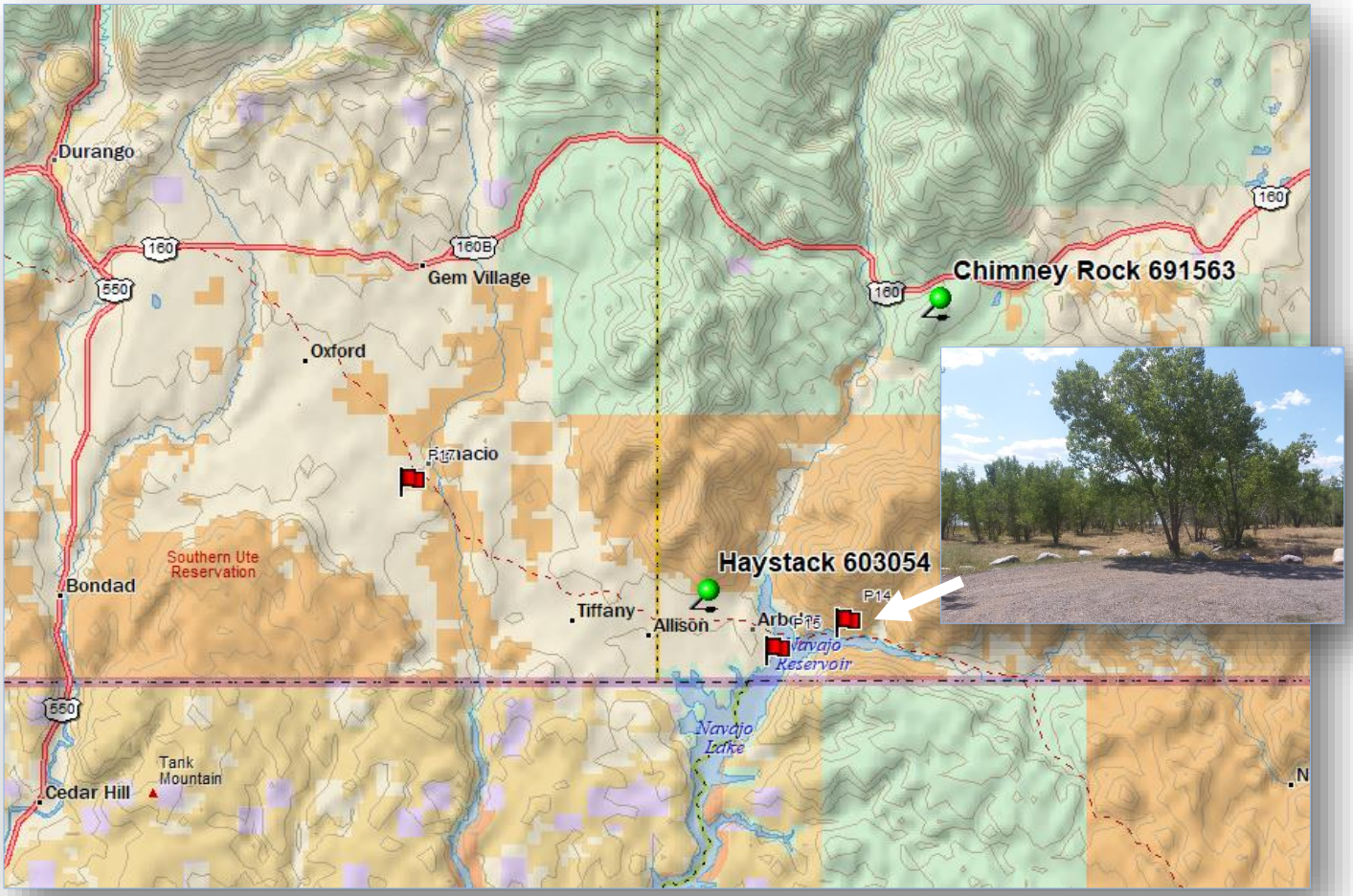


At Cuba Fairgrounds with Colorado potato beetle (IB pointing out plants)

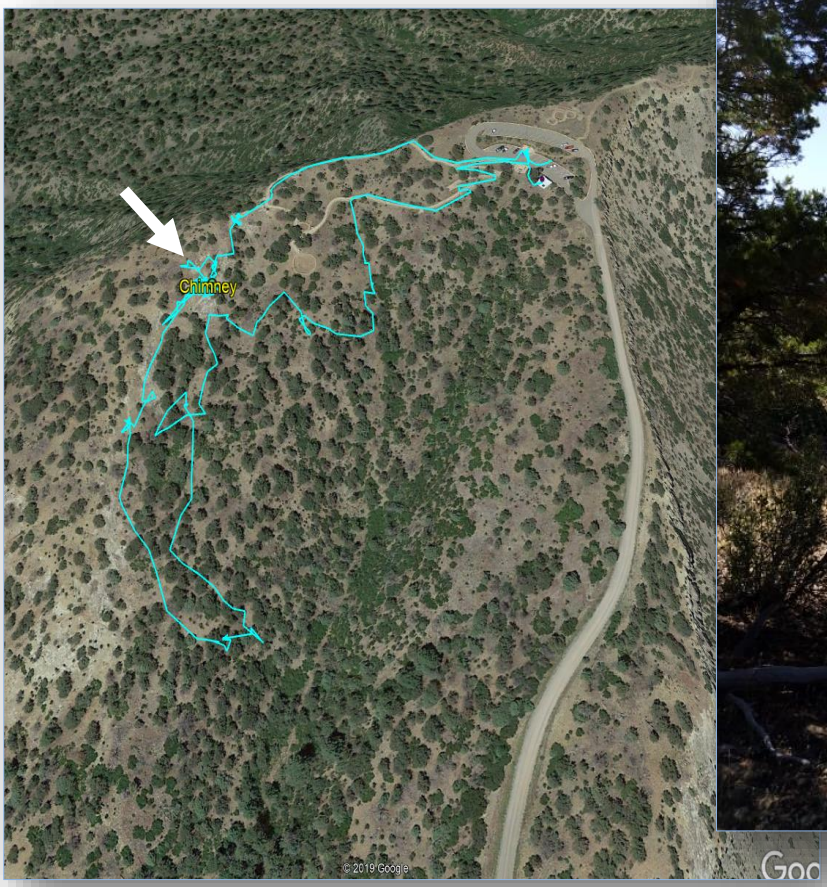
At November 1st visit

Revisited site of previous germplasm collection PI 620876 at Counselors.

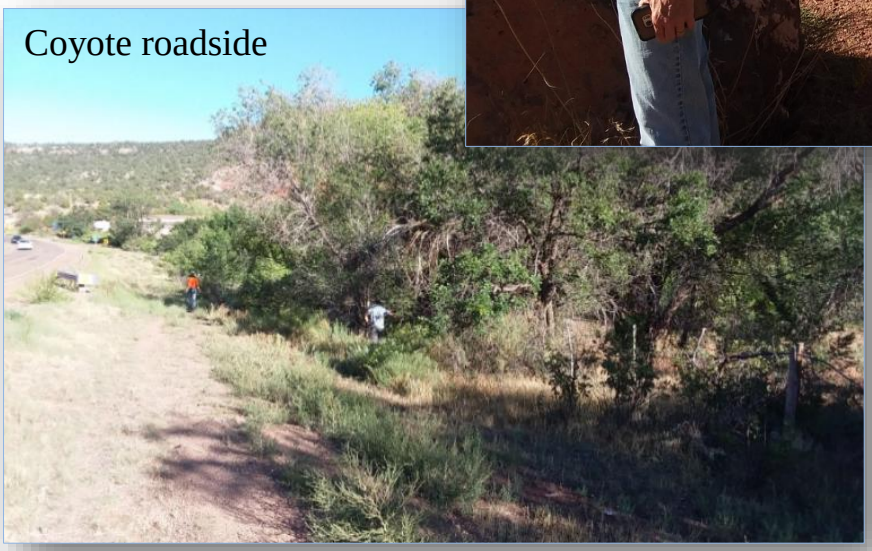
Navajo Lake environs, Colorado. Shown (L-R) Carol Thiele, BV, IB, JB at “Haystack” orchard.



Chimney Rock. Showing (L-R) ME, DK, CF, LS, JB (lower pic R = CF). JB track shown with arrow at collection site.



Abiquiu Lake area. Culvert and Coyote collection sites (green pin) and other (red flags) herbspec reports to look

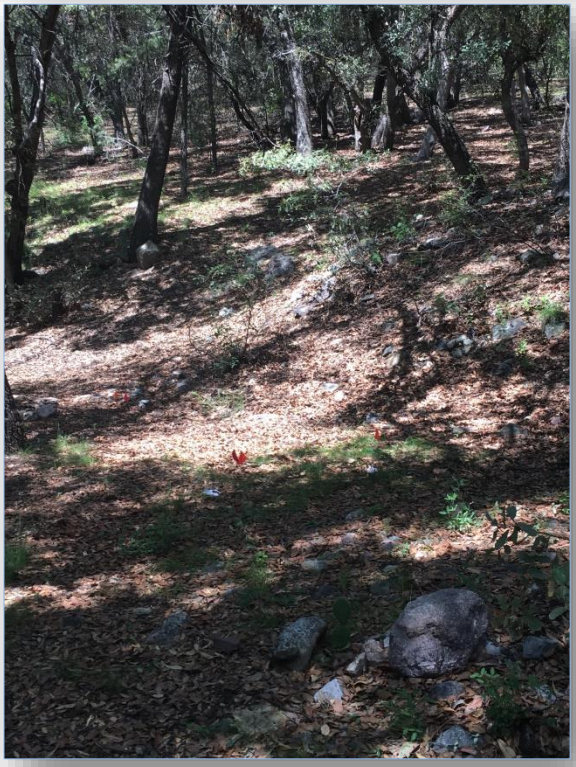


RED team site visuals.

Around Iron Creek site. Emory Pass and Railroad Campground (no collection).

Mile marker 17 on 90 between Silver City and Lordsburg (no plants found).

Parker Canyon near Parker Lake and Ida Canyon (DNA collection only)

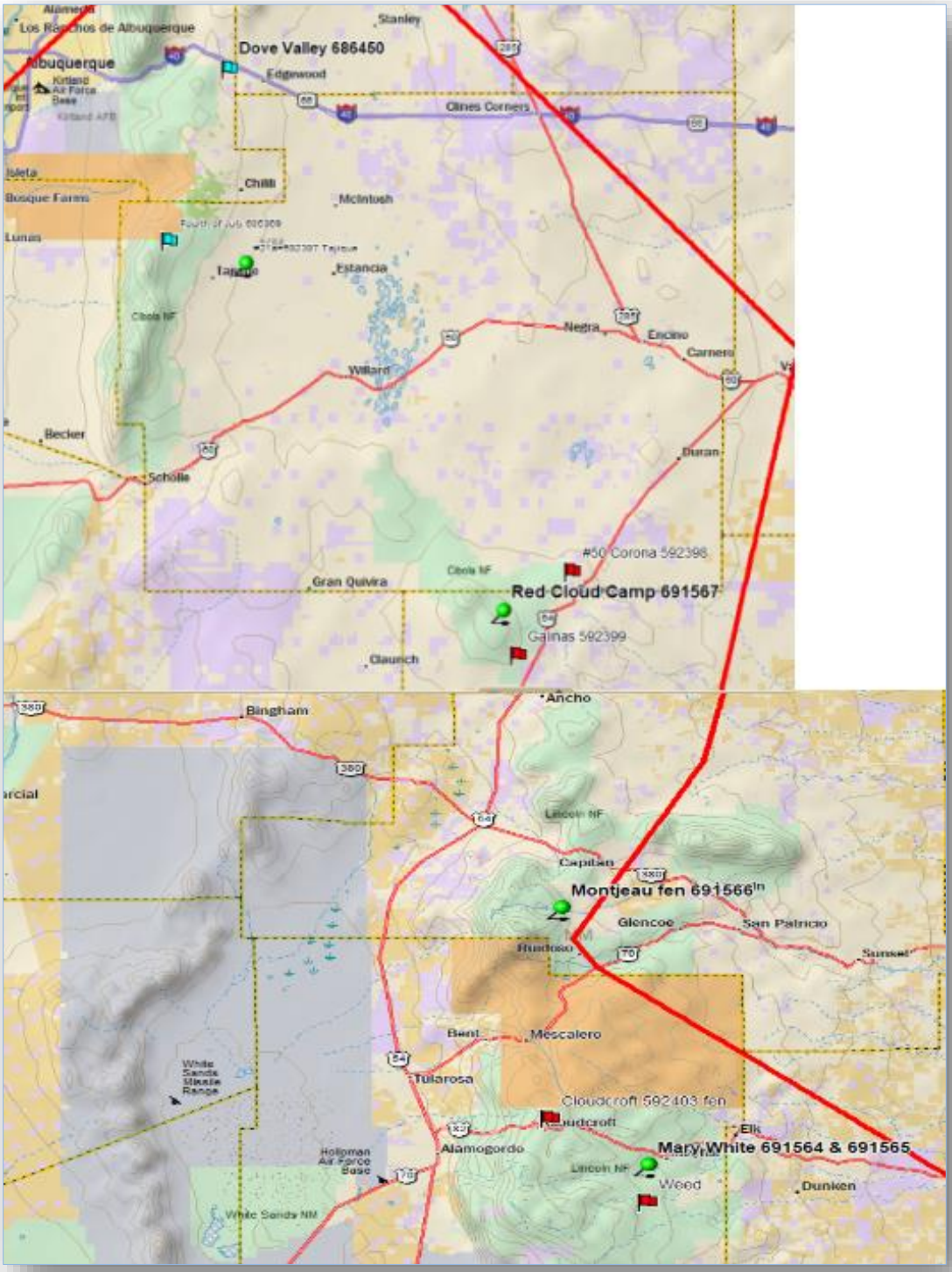


PY and MM at Ida Canyon

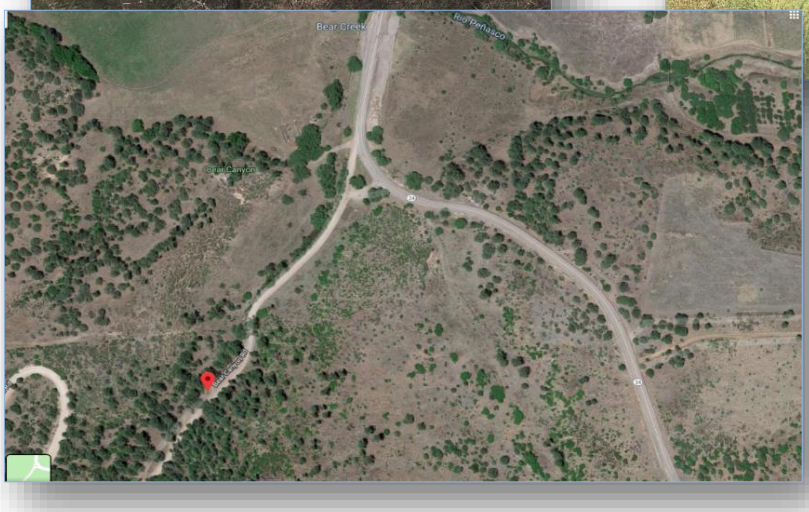
Sunny Flat Camp jam area at FR42 bridge site of PI 689431 (no collection).

Smuggler Pass near El Paso (no plants found)

Collection sites in Lincoln NF around Cloudcroft, at Monjeau Lookout, and Dove Valley



Mary White campground (new collection site for both species)



Monjeau Lookout Peak *fendleri* (collected 691566). See previous PI 458413 and PI 564045.

Red Cloud site—both species collected

Dove Valley *jamesii*

MM at Dove Valley

Nearly 100% survival of live plants brought back to the genebank this year.