# Field Observations On Progeny Of sac Plants August – November 2005

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-Cross fertility of sac plants with each other and with alfalfa was lower than cross fertility within alfalfa, but provided enough seed for research. The sac plants were essentially self-sterile, but self tripping with a pollination stick helped accumulate pollen, and sufficient self-seed for field planting was produced on sac-2.

-We focused on five sac plants: sac-2, -3, -4, -9, and –10. These plants were crossed with dormant and non-dormant alfalfa testers.

-Seeding was delayed because of drought. All materials were seeded after the longest day of the year, when days were gradually shortening, and this may have reduced summer dormancy. Due to late planting, drought conditions, and probable genotypic effects, no more than half of the plants in seeded lines flowered during the season.

-It was a great summer for observing traits not seen before, in spite of the drought. Sectored flowers (late mitotic mistakes) and sometimes side branches with sectored flowers (early mitotic mistakes) were common in progeny of sac X sac crosses. (See the earlier report with pictures of sectored flowers observed in the greenhouse) Multifoliolate leaves were common, which supports the notion that they are the result of recombination involving diverse genomes.

-The largest leaves that we have ever seen in *Medicago*, at any ploidy level, occurred in the progeny of sac-4 (see the following picture of leaves). The plant that had the largest leaves (pictured) probably is a sexual polyploid involving n and 2n gametes, which would make the plant a hexaploid. This adds meiotic mistakes to the list of mistakes. The plant did not flower in the field, and was moved to the greenhouse in November; hence, we may learn more about the plant this winter.

-Heterosis in the hybrid progeny of sac plants crossed with dormant, and non-dormant testers was impressive. In fact it was so impressive that the crosses will be repeated and evaluated in replicated micro-plots, by collaborators in other parts of the world.

-What about new hybrids? Only about 20 potential hybrid seeds were produced in the last greenhouse season because our *M. arborea* did not flower well. Most of the progeny have been selfs, but two progeny expressing yellow pigment in the flowers were obtained, and one of them is in the hands of a laboratory that can do the DNA work. Hence, there should be some DNA results in the coming year.

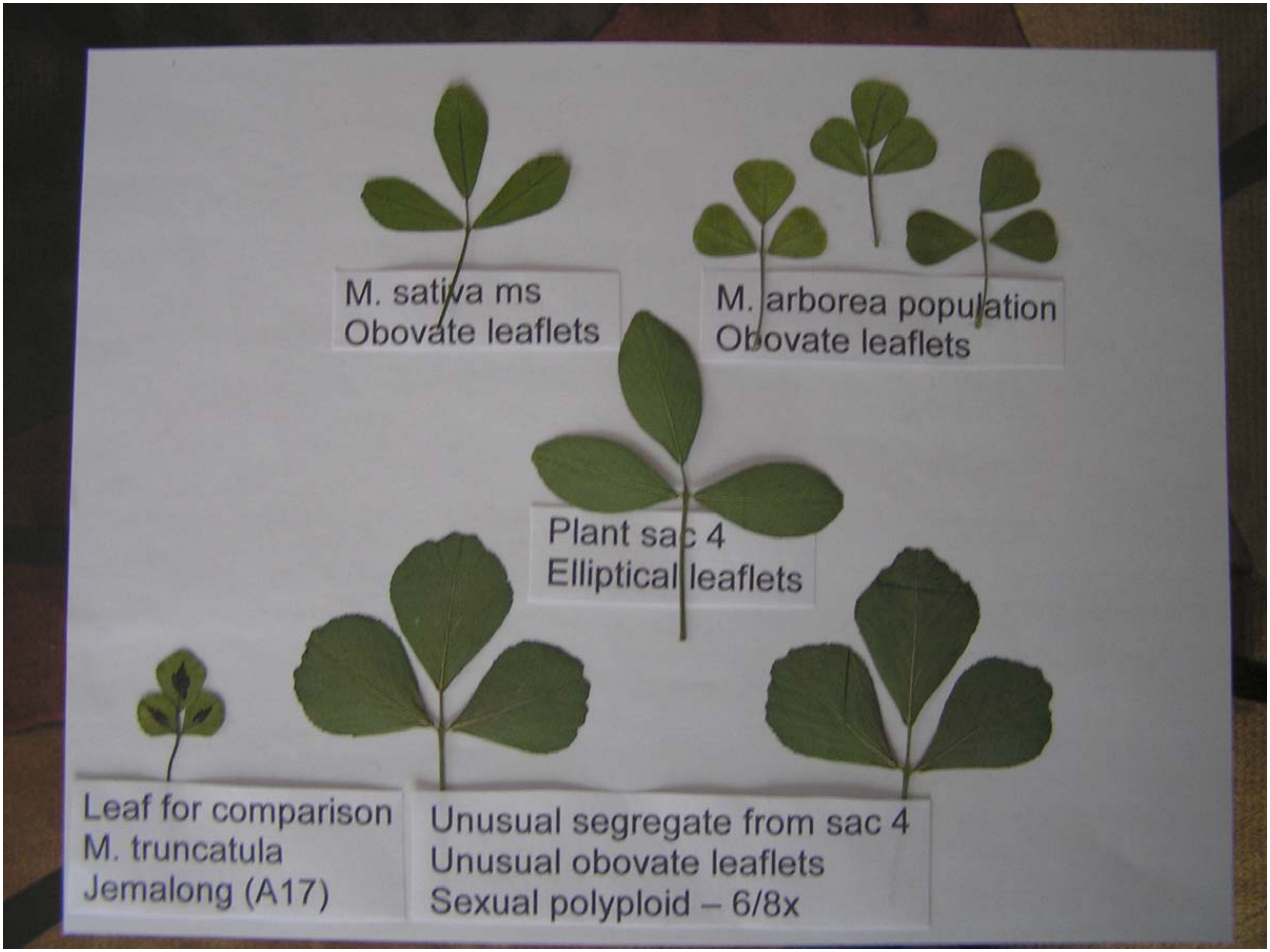
-Flowering and pollen production of *M. arborea* in the last greenhouse season was bad news and good news. The bad news was that only one *M. arborea* plant produced enough flowers and pollen for the hundreds of crosses needed in the wide hybridization work. The good news was that we were not tempted to use bulk pollen from multiple pollen donors, and all of the crosses were made with one *M. arborea* genotype. Also, we believe that we have identified what we were doing wrong in transplanting our *M. arborea* plants from the field to the greenhouse. In short, we may have been pruning too heavily. We have always removed most of the foliage to reduce water loss after transplanting, and we may have removed growing points that were programmed to flower. We have noticed that flowers seem to be produced in the greenhouse on intact branches produced in the previous season. Therefore, most of the summer growth was left on the *M. arborea* plants moved to the greenhouse this season. They wilted, and lost a lot of leaves; but, they have recovered, and we are hoping for better flowering this season.

-Another thing we have learned about *M. arborea* is that there is considerable variation in the branching pattern at and below the ground level. Whereas the ones from Greece that we reported on last year had no below ground development, some others observed this year from Spain, and France, have considerable below ground development (see picture that follows).

-The winter-active growth habit of *M. arborea* has convinced us to join it, rather than fight it. To this end, we have retrieved crosses of our male steriles X non-dormants from our seed inventories, and already have made some backcrosses to non-dormants. We have noticed in this work that all the non-dormant materials we have used thus far have tended to be maintainers. This year, we will be using male steriles that are 87% non-dormant in crosses with *M. arborea*.

-The self progeny of sac-2 (the F2 generation) were allowed to produce open-pollinated seed. Fertility ranged from about like sac-2 (less fertile than alfalfa) to near sterile, and sterile. The F2 generation of sac-2 had a high frequency of sterile plants relative to alfalfa. There was considerable variation for other observable traits. This included, vigor, growth habit, second growth at the base, time of flowering, pod shape, seed size, narrow versus branching crown, and so forth. This variation suggested that there probably was random chromosome pairing and tetrasomic segregation in sac-2. In contrast to this however, there was no segregation at the purple-flower color locus P, in that no cream or yellow progeny were observed among about 150 F2 progeny that flowered. This suggested that there was preferential pairing and disomic segregation at the P locus, assuming sac-2 is duplex (PP--). At the time we dug plants this fall, we noticed that only about half of the F2 progeny had flowered, and this could have affected the segregation, if the cream and yellow progeny happen to be weaker. Hence, we will keep studying this material. It is safe to say that this is the first time that we have seen the P locus fail to segregate in duplex material.

*Medicago* leaves collected in a field nursery, Madison, WI, early September, 2005.



*Medicago arborea* root-shoot transition area. The steel spatula is placed at the ground level. Note the small white shoots developing below the ground level, and the proliferation of small green shoots at ground level.