

APACHE ARROWLEAF CLOVER

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Background. Arrowleaf clover (*Trifolium vesiculosum* Savi.) is a winter annual forage legume that has been very important in forage systems across the southern region, including Texas. Arrowleaf is primarily overseeded on warm-season grass pastures to provide grazing or hay when the grasses are dormant. Virus and fungal diseases can severely reduce arrowleaf clover production and persistence, with bean yellow mosaic virus (BYMV) causing severe damage and being the most prevalent of the virus diseases.

Bean yellow mosaic virus is an aphid-transmitted virus that infects a broad range of plants including 29 different clover species with red clover (*T. pratense* L.) and arrowleaf clover the two most economically important. When arrowleaf clover is infected with BYMV a range of symptoms occurs, from plant death to dwarfing, leaf rugosity, leaf chlorosis, and leaf mosaic. Arrowleaf plants infected with BYMV have reduced forage yield, a shorter growing season, and delayed flowering. Visually, plants appear stunted, with short stems and small leaves. Leaves typically express a mosaic pattern of chlorosis (yellowing).

Research Findings. Apache arrowleaf clover was developed at Overton through seven cycles of selection for tolerance to bean yellow mosaic virus (BYMV) disease. Apache was released by the Texas Agricultural Experiment Station, Texas A&M University System on Oct. 3, 2001. The base population for the development of Apache was 78 half-sib arrowleaf families from a field selection program that used the arrowleaf cultivars 'Yuchi', 'Meechee' and 'Amclo' as initial germplasm. Five cycles of selection for tolerance to BYMV in arrowleaf clover were conducted under greenhouse conditions using mechanical inoculation with BYMV-KY204-1. Two additional cycles of selection were made under field conditions, also using mechanical inoculation with BYMV.

Twenty-one plants were identified in cycle 7 that survived BYMV infection in combination with severe root rot disease. These selections were evaluated for seed production, which ranged from none to 81 g/plant. Based on seed production, the best eight half-sib families were bulked and breeder seed was produced in Oregon in 1999 with the experimental designation TX-AL98-1.

The most striking response of arrowleaf clover to infection with BYMV is a rapid, systemic wilting beginning on youngest growth 8-13 days post-inoculation and resulting in plant death. We studied the inheritance of this trait and determined that resistance to BYMV-induced

lethal wilt is conferred by the homozygous recessive form of the *L* gene in arrowleaf clover. The lethal wilt allele, *L*, is present in 15-23% of the Yuchi arrowleaf clover population. Lethal wilt (BYMV-induced) also occurs in Amclo and Meechee arrowleaf clover at 6-10% and 18-25%, respectively. One cycle of selection, using mechanical inoculation with BYMV, eliminated the susceptibility (*LL* or *Ll*) to this component of BYMV disease.

The resistance of Apache arrowleaf to BYMV-induced lethal wilt was confirmed in a greenhouse experiment. Apache and Yuchi arrowleaf clover were planted on 16 Oct. 2000 and at two months of age the seedlings were transplanted to 6-inch pots. On 2 April 2001 the plants were mechanically inoculated with BYMV (KY-204-1 isolate). No plant deaths were noted on Apache (0/50; dead/number inoculated), but 35% (17/48) of the Yuchi plants died within 5 weeks, post-inoculation.

The development of BYMV tolerance was demonstrated with arrowleaf families from 4 cycles of selection where four BYMV disease components (dwarfing, rugosity, chlorosis and mosaic) and dry matter production were evaluated. Level of improvement per cycle varied by component but selection clearly improved the ability of arrowleaf clover to tolerate BYMV infection.

Apache and Yuchi arrowleaf clover were evaluated in field plots at Overton Texas during the 1999-2000 growing season. Virus disease symptoms were rated and plant survival and plant height were measured in late May. Apache had very mild virus symptoms relative to Yuchi and Apache plants were taller ($P= 0.01$) compared to Yuchi. Improvement in virus symptom score of Apache relative to Yuchi was as follows: leaf chlorosis +32%; leaf mosaic +9%; dwarfing +30%; leaf rugosity +9%; and plant height +45%. Twenty-four percent of the Yuchi plants were dead but Apache death loss was only 7 percent.

Application. Apache arrowleaf clover is tolerant to bean yellow mosaic virus disease, has excellent seedling vigor and is slightly earlier in maturity than Yuchi arrowleaf.