Revised April 2, 2003 and updated August 7, 2006.

Sweetclover Descriptors for GRIN

David M. Brenner
email: dbrenner@iastate.edu

INTRODUCTION

Sweetclover (*Melilotus*) is a forage crop in the legume family (Smith, 1951; Smith and Gorz, 1965; Bowman et al., 1998). Three of the species are cultivated: *Melilotus albus*, *M. officinalis*, and *M. indicus*. They include annual and biennial types. There are 19 species in the genus, all are native to Eurasia or North Africa (Stevenson, 1969, GRIN, 2006). As a group the sweetclovers have the advantages of high seed yields and tolerating temperature extremes, in comparison with most other forages. The nitrogen fixation rate is superior to other legumes (Stickler and Johnson, 1959) and is beneficial in crop rotations. Sweetclover is used as a model genetic organism for nitrogen fixation studies (Hirsch et al., 2000, Hirsch, 2002).

Small-plot seed production methods are well developed for sweetclover germplasm conservation. (Brenner, 2005).

REFERENCES:

Bowman, G., C. Shirley, and C. Cramer. 1998. Managing cover crops profitably. 2nd ed. Sustainable Agriculture Network handbook series bk. 3, U.S. Dept. of Agriculture. Washington, D.C.

Brenner, D.M., 2005. Methods for *Melilotus* germplasm regeneration. Plant Genetic Resources Newsletter 141:51-55.

GRIN. 2006. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). [Online Database] National Germplas Resources Laboratory, Beltsville, Maryland. Available: http://www.ars-grin.gov/cgi-bin/npgs/html/taxgenform.pl (verified 7 August 2006).

Hirsch, A.M., M.R. Lum, R.S.N. Krupp, W. Yang, and W.M. Karlowski. 2000. *Melilotus alba* Desr. white sweetclover, a mellifluous model legume. p. 627-642. In E.W. Triplett (ed.) Prokaryotic nitrogen fixation: A model system for analysis of a biological process. Horizon Scientific Press, Wymondham, UK.

Hirsch, A.M. 2002. Investigations on sweetclover molecular biology and genetics: A model legume. Available: http://www.mcdb.ucla.edu/Research/Hirsch/sweetclover.html

Smith, W.K. 1951. Sweetclover. p. 166-179. In Hughes, H.D., M.E. Heath, and D.S. Metcalfe

(eds.) Forages: The science of grassland agriculture. The Iowa State College Press, Ames, IA.

Smith, W.K., and H.J. Gorz. 1965. Sweetclover improvement. Adv. Agron. 17:163-231.

Stevenson, G.A. 1969. An agronomic and taxonomic review of the genus *Melilotus* Mill. Can. J. Plant Sci. 49:1-20.

Stickler, F.C. and I.J. Johnson. 1959. Dry matter and nitrogen production of legumes and legume associations in the fall of the seeding year. Agron. J. 51:135-137.

Category: CHEMICAL

COUMARIN BETA-GLUCOSIDASE (COUM_BE_GL)
Beta-glucosidase activity detected with the fluorescence method of F.A. Haskins and H.J. Gorz. 1970. Crop Sci. 10:479-481.

HIGH fluorescence intense yellow green or less intense (BB or Bb genotypes)

LOW fluorescence slight yellow or virtually none (bb genotype)

COUMARIN OMEGA-HYDROXYCINNAMIC (COUM_OM_HY)
Omega-hydroxycinnamic acid detected with the fluorescence method of F.A. Haskins and H.J. Gorz. 1970. Crop Sci. 10:479-481.

HIGH fluorescence yellow green (CuCu or Cucu genotypes)

LOW virtually no fluorescence (cu genotype)

COMMENTARY ON THE COUMARIN DESCRIPTORS (COUM_BE_GL) and (COUM_OM_HY)

The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring COUM_OM_HY information is a high priority, and COUM_BE_GL information is a medium priority.

The most important of these descriptors is COUM_OM_HY because Cu governs coumarin production. The COUM_BE_GL descriptor is less important because the B allele has no apparent effect without Cu. Fresh leaves of the B genotypes taste bitter if the Cu allele is also present. Non-bitter leaves have the genotypes Cu-bb, cucuB- , or cucubb. It is important to distinguish between non-bitter types because Cu-bb genotypes can become toxic (Smith and Gorz, 1965). Plants with cucuB- are low coumarin and also non-bitter.

Hay made from *Melilotus* plants that contain coumarin, can become toxic to animals (sweetclover bleeding disease), especially cattle, if the hay is spoiled by moisture and decay (Smith and Gorz, 1965).

Before the discovery of Cu, the cultivar PIONEER was released to prevent coumarin toxicity, but was toxic because of this hidden gene, even though it is non-bitter. Newer low coumarin varieties of *M. albus* are in fact low coumarin, these include: ACUMAR, CUMINO, DENTA (Smith and Gorz, 1965) and POLARA (Goplen, 1971). The *M. officinalis* lines N28 and N29 are low coumarin (Gorz et al., 1992) as is the cultivar NORGOLD (Goplen, 1981). *M. dentatus* plants are also low coumarin although they are wild rather than cultivated (Smith and Gorz, 1965).

The sample population size and frequency in percent are to be included with each observation code. A single evaluation of one accession can require up to four observations in GRIN if it has both levels of fluorescence for both descriptors. Intermediate levels of fluorescence, which can detect heterozygous genotypes (Haskins and Gorz, 1970) were combined in this descriptor to simplify the data and reduce data gathering effort.

REFERENCES:

Goplen, B.P., 1971. Polara, a low coumarin cultivar of sweetclover. Can. J. Plant Sci. 249-251.

Goplen, B.P., 1981. NORGOLD - A low coumarin yellow blossom sweetclover. Can. J. Plant Sci. 61:1019-1021.

Gorz, H.J., F.A. Haskins, G.R. Manglitz, R.R. Smith, K.P. Vogel. 1992. Registration of N28 and N29 Sweetclover Germplasms. Crop Sci. 32:510.

Haskins, F.A., and H.J. Gorz. 1970. Rapid detection of o-hydroxycinnamic acid and beta-glucosidase in *Melilotus alba*. Crop Sci. 10:479-481.

Smith, W.K., and H.J. Gorz. 1965. Sweetclover improvement. Adv. Agron. 17:163-231.

Category: COMMENT

COMMENT

Casual observations made by cooperators or curators while evaluating or regenerating germplasm. Usually these observations are not published and need verification.

Category: CYTOLOGIC

SOMATIC CHROMOSOME NUMBER (SOMCHRMNUM)

Somatic chromosome number (2n), and MIX if more than one number is in the accession (and comment to explain).

COMMENTARY ON SOMATIC CHROMOSOME NUMBER (SOMCHRMNUM)
The CGC has determined that acquiring this information is a high priority.

Category: DISEASE

ANTHRACNOSE (STEM_ANTHRAC)
Anthracnose (*Colletotrichum trifolii*)

Anthracnose (*Colletotrichum trifolii*) resistance. The percent of each level of resistant plants (lesion type), and sample size.

Melilotus methods are not developed, but might be adapted from the *Medicago* methods. This scale is adapted from Ostazeski and Elgin. 1984, in USDA Misc. Publ. 1434.
Scale

RESIST	stems have no lesions or only small water soaked spots (Type 1)
SLIGHT	long narrow lesions with few, if any, acervuli and no sporulation (Type 2)
MOD	lesions are long and wide, not girdling, with acervuli usually present (Type 3)
SEVERE	lesions are large, coalescing, and sporulating eventually girdling and kiling the stems (Type 4)
DEAD	plant dead (Type 5)

COMMENTARY ON ANTHRACNOSE (STEM_ANTHRAC)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The lesion types RESIST and SLIGHT can be classified as resistant.

The sample population size and frequency in percent are to be included with each observation code. Therefore a single evaluation of one accession, can require up to five observations in GRIN if it has all five levels of susceptibility.

Methods have not been developed for this disease screening in *Melilotus*, but the following references could be useful in adapting methods from *Medicago*. Jones (1950) and Potts (1955) have some information specifically on *Melilotus*.

REFERENCES:

Jones, F.R. 1950. Susceptibility of alfalfa plants to *Colletotrichum trifolii*. Plant Dis. Rep. 34:344.

Ostazeski, S.A.,1990. Anthracnose. p. 23-24. In Stuteville, D.S. and D.C. Erwin. (eds.) Compendium of alfalfa diseases. 2nd edition. APS Press. St. Paul, MN.

Ostazeski, S.A., and J.H. Elgin Jr. 1984. Anthracnose resistance. p. 21. In Standard tests to characterize pest resistance in alfalfa cultivars. USDA Misc. Publ. 1434. U.S. Gov. Print. Office, Washington, DC.

Potts, R.C. 1955. Sweetclover in Texas. Bull 791. Texas Ag. Exp. Stn., Texas A&M., College Station.

FUSARIUM ROOT ROT (ROOT_FUS)

Fusarium culmorum crown and root rot. The percentage of plants with each rating, and sample size, following the inoculation method of M.W. Cormack 1937 Can. J. Res. 15:493-510, or equivalent methods.

Plants rated NONE or SLIGHT are considered resistant.

NONE	no discoloration in the root
SLIGHT	small dark strands in the stele
MOD_SM	small dark-brown arcs or rings in cross section of the stele
MOD_LG	larger dark-brown areas, arcs or rings, or partial dark-brown ring in the outer stele
SEVERE	entire outer stele dark brown, plant alive
DEAD	plant dead

PHYTOPHTHORA ROOT ROT (ROOT_PHYT)

Phytophthora crown and root rot. The percentage of plants with each rating, and sample size, following the inoculation method of F.R. Jones 1939. Phytopathology 29:909-911, or equivalent methods. Plants rated NONE or SLIGHT are considered resistant.

NONE	roots clean with no lesions and many small rootlets present on the taproot
SLIGHT	only very small superficial lesions (2 mm) present on taproot, taproots usually lack numerous branch roots, and most lesions occur at site where branch root had started growth
MOD_SM	one or more large lesions on tap root, but none girdling the taproot, the tips of one or more larger branch roots rotted off
MOD_LG	extensive root lesions with the taproots usually rotted off 10 cm or more below the crown

SEVERE	taproot almost completely destroyed but plant alive
DEAD	plants dead

SCLEROTINIA ROOT ROT (ROOT_SCL)

Sclerotinia sp. crown and root rot. The % of resistant plants, and sample size, inoculation method of Sanford, G.B. and Cormack, M.W. 1935. p. 290-393. Proc. Worlds Grain Exhib. and Conf., Vol. 2., or equivalent.

Information on the species of *Sclerotinia* should be included in the environment comment.

NONE	roots clean with no lesions and many small rootlets present on the taproot
SLIGHT	only very small superficial lesions (2 mm) present on taproot, taproots usually lack numerous branch roots, and most lesions occur at site where branch root had started growth
MOD_SM	one or more large lesions on tap root, but none girdling the taproot, the tips of one or more larger branch roots rotted off
MOD_LG	extensive root lesions with the taproots usually rotted off 10 cm or more below the crown
SEVERE	taproot almost completely destroyed but plant alive
DEAD	plants dead

COMMENTARY ON CROWN AND ROOT ROTS (ROOT_FUS), (ROOT_PHY), (ROOT_SCL).

The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring information for *Fusarium* and *Phytophthora* are medium priorities. The priority for *Sclerotinia* is not determined.

The sample population size and frequency, in percent, are to be included with each observation code. A single evaluation of one accession, can require multiple observations in GRIN if multiple reaction types are present.

Both Jones (1939) and Comstock (1942) found resistance to *Phytophthora* crown and root rot. Sanford and Cormack (1935) found resistance to *Sclerotinia*. Resistance to the fusarium complex has not been found in *Melilotus* (Smith and Gorz, 1965). Most of the following references are about ways to screen for disease resistance and identify pathogens. Most of the rating scales are adapted from the U.S. Department of Agriculture, Agricultural Research Service. 1984. Standard tests to characterize pest resistance in alfalfa cultivars. Additional methods could be adapted from the alfalfa (*Medicago*) literature included in the references.

Crown and root rots can be a secondary result of infestation by sweet clover weevils (Charles

Block, unpublished). Weevil infestation must be detected early, when symptoms first appear, before the roots decay.

REFERENCES:

Benedict, W.G. 1954. Studies on sweet clover failures in southwestern Ontario. Can. J. Bot. 32:82-94.

Cormack, M.W. 1937. *Fusarium* spp. as root parasites of alfalfa and sweet clover in Alberta. Can. J. Res. Sect. C 15:493-510.

Cormack M.W. 1942. Varietal resistance of alfalfa and sweet clover to root and crown-rotting fungi in Alberta. Sci. Agric. (Ottawa) 22:775-786.

Cormack, M.W. 1948. Winter crown rot or snow mold of alfalfa, clovers, and grasses in Alberta. I. Occurrence, parasitism, and spread of the pathogen. Can. J. Res. Sect. C 26:71-85.

Cormack, M.W. 1952. Winter crown rot or snow mold of alfalfa, clovers, and grasses in Alberta. II. Field studies on host and varietal resistance and other factors related to control. Can. J. Bot. 30:537-548.

Farr, D.F., G.F. Bills, G.B.Chamuris, and A.Y. Rossman 1989. Fungi on plant products in the U.S. APS Press. St. Paul, MN.

Jones, F.R. 1939. Evidence of resistance in sweetclover to a *Phytophthora* root rot. Phytopathology 29:909-911.

Lebeau J.B. and J.D. Dickson. 1955. Physiology and nature of disease development in winter crown rot of alfalfa. Phytopathology 45:667-673.

Lebeau, J.B. and C.E. Logsdon. 1958. Snow mold of forage crops in Alaska and Yukon. Phytopathology 48:148-150.

Sanford, G.B. and Cormack, M.W. 1935. On varietal resistance of *Medicago* and *Melilotus* to root rots caused by *Sclerotinia* sp. and *Plenodomus meliloti* D.&S. p. 290-393. In Proc. World's Grain Exhib. and Conf., Vol. 2. Regina, Canada 24 July to 5 Aug. 1933. The Can. Soc. of Technical Agriculturists, Ottawa, Canada

Slykhuis, J.T. 1952. Investigations on sweetclover failure in southwestern Ontario. Sci. Agric. (Ottawa) 32:1-18.

Smith, W.K., and H.J. Gorz. 1965. Sweetclover improvement. Adv. Agron. 17:163-231.

Stuteville, D.S. and D.C. Erwin. 1990. Compendium of alfalfa diseases. 2nd edition. APS Press.

St. Paul, MN.

U.S. Department of Agriculture, Agricultural Research Service. 1984. Standard tests to characterize pest resistance in alfalfa cultivars. U.S. Department of Agriculture Miscellaneous Publication No. 1434.

SEED ROTS (SEED_ROT)
Seed rotting (*Fusarium, Pythium, Rhizoctonia*)

The pathogens that are used to inoculate sand at the time of seeding, the percentage of germinable seeds per non-inoculated control that produced seedlings still living 15 days after seeding, and the sample size.

COMMENT
Use the greenhouse-sand inoculation system of J.E. Halpin and E.W. Hanson. 1958. Phytopathology 48:481-485.

COMMENTARY ON SEED ROTS (SEED_ROT)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a medium priority.

REFERENCES:

Halpin, J.E., and E.W. Hanson. 1958. Effect of age of seedlings of alfalfa, red clover, ladino white clover, and sweetclover on susceptibility to *Pythium*. Phytopathology 48:481-485.

Halpin, J.E., E.W. Hanson, and J.C. Dickson. 1954. Studies of the pathogenicity of seven species of *Pythium* on alfalfa, sweetclover, and ladino clover seedlings. Phytopathology 44:572-574.

Jacobs, J.A. 1947. Factors affecting seed rotting caused by *Pythium* spp. in sweetclover with preliminary tests in alfalfa and red clover. J. Am. Soc. Agron. 39:702-718.

SPRING BLACKSTEM (STEM_SPR_BL)
Blackstem (*Phoma medicaginis* also known as spring blackstem on alfalfa) rated with the greenhouse inoculation system of G.C.M. Latch and E.W. Hanson. 1962. Phytopathology 52:300-315.

NONE	no infection
SLIGHT	slight infection, a few spots on the leaves
MOD	slight to moderate infection, some defoliation, and a few small stem lesions
SEVERE	severe leaf lesions resulting in much defoliation, moderate stem lesioning

GIRD	plant recovered from below girdled stems but may be stunted
DEAD	plant dead

COMMENTARY ON SPRING BLACKSTEM (STEM_SPR_BL)
The Clover and Special Purpose Legume, Crop Germplasm Committee has determined that acquiring this information is a high priority.

The population size and frequency in percent are to be included with each observation code. A single evaluation of one accession can require up to six observations in GRIN if all six reaction types are present.

REFERENCES:

Farr, D.F., G.F. Bliss, G.P. Chamuris, A.Y. Rossman. 1989. Fungi on plant products in the United States APS. Press. St. Paul, MN.

Gorz, H.J. 1955. Inheritance of reaction to *Ascochyta caulicola* in sweetclover (*Melilotus alba*). Agron. J. 47:379-383.

Latch, G.C.M,. and E.W. Hanson. 1962. Comparison of three stem diseases of *Melilotus* and their causal agents. Phytopathology 52:300-315.

Stuteville, D.S. and D.C. Erwin. 1990. Compendium of alfalfa diseases. 2nd edition. APS Press. St. Paul, MN.

STEM CANKER OR GOOSENECK (STEMCANKER)

Stem canker or gooseneck (*Ascochyta lethalis* also known as *Ascohyta caulicola, A. meliloti*, and *Phoma* sp.) greenhouse evaluation protocol of G.C.M. Latch and E.W. Hanson. 1962. Phytopathology 52:300-315.

NONE	no infection
SLIGHT	slight infection, a few spots on the leaves
MOD	slight to moderate infection, some defoliation, and a few small stem lesions
SEVERE	severe leaf lesions resulting in much defoliation, moderate stem lesioning
GIRD	plants recovered from below girdled stems but may be stunted
DEAD	plants dead

COMMENTARY ON STEM CANKER OR GOOSENECK (STEMCANKER)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The sample population size and frequency, in percent, are to be included with each observation

code. A single evaluation of one accession can require up to six observations in GRIN if all six reaction types are present. The older ratings in GRIN (ASCCAU1 and ASCCAU2) are general observations for entire populations, and should be retained until replaced by percentage data.

REFERENCES:

Farr, D.F., G.F. Bliss, G.P. Chamuris, A.Y. Rossman. 1989. Fungi on plant products in the United States. APS Press. St. Paul, MN.

Gorz, H.J. 1955. Inheritance of reaction to Ascochyta caulicola in sweetclover (*Melilotus alba*). Agron. J. 47:379-383.

Latch, G.C.M,. and E.W. Hanson. 1962. Comparison of three stem diseases of *Melilotus* and their causal agents. Phytopathology 52:300-315.

SUMMER BLACK STEM (STEM_SUM_BL)
Summer blackstem (*Cercospora davisii*) rated with the greenhouse inoculation system of G.C.M. Latch and E.W. Hanson. 1962. Phytopathology 52:300-315.

NONE	no infection
SLIGHT	slight infection, a few spots on the leaves
MOD	slight to moderate infection, some defoliation, and a few small stem lesions
SEVERE	severe leaf lesions resulting in much defoliation, moderate stem lesioning
GIRD	plants recovered from below girdled stems but may be stunted
DEAD	plants dead

COMMENTARY ON SUMMER BLACK STEM (STEM_SUM_BL)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The sample population size and frequency in percent are to be included with each observation code. A single evaluation of one accession can require up to six observations in GRIN if all six reaction types are present. The older ratings in GRIN, (CERDAV1 and CERDAV2) are general observations for entire populations, and should be retained until replaced by percentage data.

REFERENCE:

Latch, G.C.M,. and E.W. Hanson. 1962. Comparison of three stem diseases of *Melilotus* and their causal agents. Phytopathology 52:300-315.

Category: GROWTH

HEIGHT OF 1ST YEAR BIENNIAL (HEIGHT_VEG)

Height (stem length) of vegetative (first year biennial) plants measured from the soil in cm, before lodging. Recorded September 1.

If distinctly different size classes are present; report the most common plant height in each class. Each observation includes population size, and percentage of the population.

HEIGHT OF FLOWERING PLANTS (HEIGHT_FL)

Height (stem length)of flowering plants measured from the soil in cm, before lodging. Recorded any time after 50% of the plants have open flowers.

If distinctly different size classes are present; report the most common plant height in each class. Each observation includes population size, and percentage of the population.

COMMENTARY ON PLANT HEIGHT (HEIGHT_FL and HEIGHT_VEG)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a medium priority.

There are two descriptors here, to separate the height data of flowering-year plants from height data of first-year biennial plants which do not flower and are usually shorter. "Height" measurements should include the length of fallen stems, measured as though the stems had not fallen.

The most useful data would be taken on non-transplanted, field-grown, widely spaced plants, after 50% of the plants have open flowers. Data taken in other environments can also be included in GRIN, but the limitations of the environment should be mentioned.

In most accessions, only one measurement of the most common height is adequate. However, in some accessions, there are more size classes, such as short plants mixed with tall plants.
The less common size classes should be reported as separate entries. This format allows data on rare plant forms, which could be useful in plant breeding.

An example of data in this format:

GRIN field:	Descriptor	Observation	Frequency	Sample size
Data:	HEIGHT_FL	100 cm	80%	100
	HEIGHT_FL	30 cm	20%	100

Data in the old plant height format (Maximum Plant Height (MAXPLTHGT) and Minimum Plant Height (MINPLTHGT) should be kept in GRIN until superceded by better data.

PLANT GROWTH HABIT (GROW_HABIT)

Plant growth habit evaluated when 50% of the plants have open flowers.

The most useful data are from non-transplanted, field-grown, widely spaced plants. Data taken in other sub-optimal environments can also be included in GRIN, but the limitations of the environment should be mentioned. Standard check varieties should be established.

1 prostrate
2
3
4
5 medium
6
7
8
9 very erect

COMMENT
COMMENTARY ON PLANT GROWTH HABIT (GROW_HABIT)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a medium priority.

Standard check varieties have not been established, but should be.

The stems tend to bend outward and downward during flowering, but spring upwards as the seeds shatter and the old leaves abscise. The most useful data would be taken on non-transplanted, field-grown, widely spaced plants, when 50% of the plants have open flowers. Data taken in other environments can also be included in GRIN, but the limitations of the environment should be mentioned.

In comparison with very similar older descriptors, (GWT-HAB1, and GWT-HAB2) the order of prostrate to erect is reversed. This system (PLANT GROWTH HABIT) with 1 = prostrate, and 9 = erect is preferred here because it is consistent with other crops in GRIN. The new format (PLANT GROWTH HABIT) also allows many contrasting data sets and the old format only presented the highest and lowest observations. Data in the old formats should be kept until superceded by better data.

SEEDLING VIGOR (SDLG_VIGOR)
Visual estimate of vegetative growth 6 weeks after seeding, coded 1-9.

1 good (highest)
2
3
4
5 medium
6
7
8
9 poor

COMMENTARY ON SEEDLING VIGOR (SDLG_VIGOR)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The new format (SDLG_VIGOR) is like the old formats (MINSDLGVIG) and (MAXSDLGVIG) except that the new format allows many contrasting data sets and the old format only presented the highest and lowest observations. Data in the old formats should be kept until superceded by better data.

The most useful data would be taken on non-transplanted, field-grown, widely spaced plants. Data taken in other environments can also be included in GRIN, but mention the environment's limitations.

SPRING VIGOR (SPRG_VIGOR)
Visual estimate of amount of vegetative growth of biennial sweetclover three to four weeks after growth starts in the second year, coded 1-9.

1 good (highest growth)
2
3
4
5 medium
6
7
8
9 poor

COMMENTARY ON SPRING VIGOR (SPRG_VIGOR)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The new format (SPRG_VIGOR) is like the old formats (MINSPRINGVIG) and (MAXSPRINGVIG) except that the new format allows many contrasting data sets and the old format only presented the highest and lowest observations. The modern GRIN format also allows specific information about the growth environment. Data in the old formats should be kept until it is superceded by better data.

The most useful data would be taken on non-transplanted, field-grown, widely spaced plants. Data taken in other environments can also be included in GRIN, but the limitations of the environment should be mentioned.

Category: INSECT
(The insect descriptors are not completed. This list is included to indicate the organization.)

WEEV-DMG (WEEVILDAM)
Sweetclover weevil is evaluated in field or greenhouse by the methods of Radcliffe and Holdaway 1967 Sweetclover weevil (*Sitona cylindricollis*) resistance in *Melilotus* Adans., *Medicago* L., and *Trigonella* L. Tech. Bul 255, Ag. Expt. Sta. Univ. of Minnesota.

COMMENTARY ON WEEV-DMG (WEEVILDAM)
The Clover and Special Purpose Legume, Crop Germplasm Committee has determined that acquiring information on resistance to sweetclover weevil is a high priority, and that acquiring information on resistance to the following five insects is a low priority.

1. Blister beetle (*Epicauta* sp.)
2. Pea aphid (*Acyrthosipon pisum*)
3. Potato leafhopper (*Empoasca fabae*)
4. Sweetclover aphid (*Therioaphis riehmi*) In GRIN as: SCA-RES (SCARES)
5. Sweetclover root borer (*Walshia amorphellia*)

Category: MORPHOLOGY

FLOWER COLOR (FLWR_COLOR)

Flower color

MIX mixture of yellow flowered and white flowered plants
OTH other
W white
Y yellow

COMMENTARY ON FLOWER COLOR (FLWR_COLOR)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a medium priority.

Flower color is a key taxonomic trait (Stevenson, 1969). Mixtures of flower colors indicate probable seed mixtures, and are unlikely to be caused by environmental effects or hybridization. Some original seed samples have mixed species which are ordinarily purified during germplasm regeneration.

The typical flower colors of *Melilotus* species*:

Species	Flower Color
M. albus Medik.	White
M. altissimus Thuill.	Yellow to golden-yellow
M. dentatus (Waldst. & Kit.) Pers.	Yellow or pale-yellow
M. elegans Salzm. ex Ser.	Yellow
M. hirsutus Lipsky	Yellow or pale-yellow
M. indicus (L.) All.	Yellow or pale-yellow
M. infestus Guss.	Yellow
M. italicus (L.) Lam.	Yellow or golden-yellow
M. macrocarpus Coss. & Durieu	Pale-yellow
M. officinalis Lam.	Yellow
M. polonicus (L.) Desr.	Yellow or pale-yellow
M. segetalis (Brot.) Ser.	Golden-yellow or yellow
M. siculus (Turra) Vitman ex B. D. Jacks.	Golden-yellow
M. speciosus Durieu	White
M. spicatus (Sm.) Breistr.	Pale-yellow
M. suaveolens Ledeb.	Yellow or pale-yellow
M. sulcatus Desf.	Yellow or golden-yellow
M. tauricus (M. Bieb.) Ser.	White
M. wolgicus Poir.	White

*This list is extracted from Stevenson (1969), the nomenclature is updated to be consistent with GRIN (2006).

REFERENCES:

GRIN. 2006. USDA, ARS, National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). [Online Database] National Germplasm Resources Laboratory, Beltsville, Maryland. Available: http://www.ars-grin.gov/cgi-bin/npgs/html/taxgenform.pl (verified 7 August 2006).

Stevenson, G.A. 1969. An agronomic and taxonomic review of the genus *Melilotus* Mill. Can.

J. Plant Sci. 49:1-20.

NODULATION (NODULATION)
Amount and quality of nodulation.

1 best, 10 – 15 moderately large nodules, reddish to pink center, located on or close to the tap root
2 (between 1 = best, 6 = none)
3 (between 1 = best, 6 = none)
4 (between 1 = best, 6 = none)
5 poor nodulation
6 no nodulation

COMMENTARY ON NODULATION (NODULATION)
The Clover and Special Purpose Legume, Crop Germplasm Committee has determined that acquiring this information is a medium priority.

Include information about the strain of inoculum and how it was administered.

PLANT SHAPE (SHAPE) reference: Kirk, L.E. 1931 Sci. Agr. 11:315-325.

BUSHY	%	bushy type usually with 50 or more thin stems
STAND	%	standard type usually with 5 to 10 thick stems
OTHER	%	other plant shape (explain)

COMMENTARY ON PLANT SHAPE (SHAPE)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The sample population size and frequency in percent are to be included with each observation code. Therefore a single evaluation of one accession can require up to three observations in GRIN if it has all three plant shapes. The bushy types are occasionally observed at a low frequency in standard wild-type accessions. Bushy is usually referred to in the literature as Dwarf Bushy or Dwarf. However, since bushy plants grow to various heights and are not necessarily dwarf, the bushy descriptor is separated here from plant height.

REFERENCES:

Kirk, L.E. 1931. Inheritance of dwarf branching habit in a new variety of sweet clover and its potential economic value in breeding. Sci. Agr. 11:315-325.

Smith, W.K., and H.J. Gorz. 1965. Sweetclover improvement. Adv. Agron. 17:163-231.

Category: PHENOLOGY

DURATION (DURATION)
DEFINITION: The length of time that the plants ordinarily live before flowering and death. The biennials require a cold treatment before flowering, while annuals do not.

ANN	%	annual
BIE	%	biennial
OTH	%	other (explain)
UNK	%	did not flower when expected, so unknown
WAN	%	winter annual These perform poorly in hot summer field conditions, but do well in a winter greenhouse or similar conditions.

COMMENTARY ON PLANT DURATION (DURATION)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The sample population size and frequency in percent are to be included with each observation code. Therefore a single evaluation of one accession, can require up to four observations in GRIN if it has all four duration types.

The OTH other category could include perennial plants, which are unknown in *Melilotus*. The OTH category is intended to include unusual exceptions and therefore allow for comprehensive data.

The WAN category generally applies to Mediterranean annual species. Stevenson (1969) described their poor adaptation to temperate summer field conditions.

REFERENCE:

Smith, W.K., and H.J. Gorz. 1965. Sweetclover improvement. Adv. Agron. 17:163-231.

Stevenson, G.A. 1969. An agronomic and taxonomic review of the genus *Melilotus* Mill. Can. J. Plant Sci. 49:1-20.

MATURITY DAY FOR HAY HARVEST (HAY_DAY)
Maturity for hay forage harvest. For biennials, Julian day in the second year of growth when

50% of the plants have open flowers. For annuals, days after seeding when 50% of the plants have open flowers.

COMMENTARY ON MATURITY DAY FOR HAY HARVEST (HAY_DAY)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a high priority.

The sample population size must be included with each observation. Include field planting or field transplanting dates in the growth environment or comment fields.

Category: PRODUCTION

HUNDRED SEED WEIGHT (100SEEDWGT)

The weight in grams of 100 seeds. The weights are from the GRIN inventory database, and they generally have two significant figures.

COMMENTARY ON HUNDRED SEED WEIGHT (100SEEDWGT)
The Clover and Special Purpose Legume, Crop Germplasm Committee has determined that acquiring this information is a high priority.

Category: STRESS

STAND SURVIVAL 2ND YEAR (STAND2YR)
The percent of original plants established in the summer that resume growth in the spring of the second year, for biennials only. Include a count of the original population as the sample size. Information about the duration and severity of the winter and snow cover can be included in the growth environment or comment fields.

COMMENTARY ON STAND SURVIVAL 2ND YEAR (STAND2YR)
The Clover and Special Purpose Legume, Crop Germplasm Committee determined that acquiring this information is a medium priority.

Since these data are taken in the spring, they do not report on later-season plant death.
Data in this new format is intended to supercede older data in the SURV-PC1 (MINPCTSURV) and SURV-PC2 (MAXPCTSURV) formats. The new STAND2YR format has the advantage of separating data from differing years and environments.

Category: UNCATAGORIZED DESCRIPTORS

CORE SUBSET (CORE)
A flag to indicate the accession is part of the core subset

COMMENTARY ON CORE SUBSET (CORE)

The core subset has priority for distribution and maintenance. This core is approximately 10% of the accessions in the active *Melilotus* collection. The accessions were originally selected in 1995 based on four criteria; taxonomic identity, geographic distribution, quality of geographic information, and potential for regenerating seeds directly from collector's (original) seed under conditions of controlled pollination. The curator can add or subtract accessions from the core when the core can be improved following these criteria.

1) Each of the species in the collection is represented by at least 2 accessions, even if that species represents less than 10% of the collection.

2) Ecogeographical codes (Bailey, 1989) were determined for candidate accessions, and the widest possible distribution of codes and geographical distances are selected for each species. In *Lotus* these ecogeographical codes correlate with genetic differences (Steiner and Poklemba, 1994) the codes should be similarly useful in *Melilotus*.

3) Preference is given to those accessions that originate from a geographic point, such as a town, within a country.

4) Preference is given for accessions with control-pollinated seed lots for distribution. Some seed lots are open-pollinated, and we have no remaining original seed to grow a new control-pollinated seed lot. Open pollinated accessions are included in the core if they are the best way to satisfy the higher criteria.

Approximately eleven percent of the collection has cultivar, breeding material, or genetic material status. Although these are excluded from the core, they are valuable. They are threatened by extinction, because most are no longer available commercially. Maintaining them should be a priority near to that of the core.

REFERENCES:

Bailey, R.G. 1989. Explanatory supplement to ecoregions map of the continents. Environmental Conservation 16:307-309.

Steiner, J.J., and C.J. Poklemba. 1994. *Lotus corniculatus* classification by seed globulin polypeptides and relationship to accession pedigrees and geographic origin. Crop Sci. 34:255-264.

IMAGE (IMAGE)

A picture or image is available through GRIN.

DESCRIPTOR REVISIONS

These descriptors and the priority for data acquisition ratings were approved by the Clover and Special Purpose Legume Crop Germplasm Committee (CGC). Information about the membership and activities of the committee are available on GRIN at http://www.ars-grin.gov/npgs/cgcweb.html.

This is the long version of the sweetclover germplasm descriptor list on the GRIN computer database; revised in 2002, and minor revisions in 2006. It provides background and bibliographic references. Since sweetclover research has been neglected recently, many of the references are old. The descriptors and this document should be improved by newer research and ideas. For example, the taxonomic identity of pathogens could be further clarified.

Twenty-six descriptors are CGC approved as of 2002 and are described here. Thirty-six sweetclover descriptors on GRIN are not CGC approved and only mentioned here for comparison with approved descriptors. These older, non-approved descriptors have data, and will be kept in GRIN at least until better data are available.

The descriptors were improved with editing by C.C. Block, R.R. Smith, and M.P. Widrlechner, and helpful comments from many members of the Clover and Special Purpose Legume, Crop Germplasm Committee. Many of the descriptors were based on descriptors for other crops in GRIN.