Characterization and Evaluation of White Clover Collections

S Sareen
Indian Grassland and Fodder Research Institute, Regional Research Centre, CSKHPKV Campus, Palampur-176 062 Himachal Pradesh

Seventy-seven lines of white clover, a temperate forage species, comprising sixty local collections made from different altitudes in Himachal Pradesh and seventeen exotic accessions procured from IGER, UK, were evaluated for twenty morphological parameters. Most of the characters exhibited variability both within and between populations. Based on overall morphology, the populations were grouped into eight groups. The populations with desirable traits were identified for further use in white clover improvement.

Key Words: Persistence, *Trifolium repens*, Variability, White Clover

White clover (*Trifolium repens*) is a sub-temperate – temperate forage species found where soil moisture is adequate for growth. It is the predominant legume sown in most grazed pastures, improving forage quality and providing upto 400kg N/ha in swards annually through N-fixation (Crush, 1987). The stoloniferous growth and phenotypic plasticity make it an ideal companion legume in most grass swards and enable it to withstand severe defoliation (Woodfield and Caradus, 1994). Despite these advantages, it is not popular among farmers in Himachal Pradesh and other sub-temperate and temperate regions in India, although it constitutes predominant component of flora of these regions. This calls for its improvement so that farmers can adopt it. Phenotypic recurrent selection within adapted germplasm pools has been by far the most common means of population improvement in white clover (Williams, 1987). In the present study seventy-seven collections of white clover were evaluated for identification of superior lines which can be used for its improvement.

Material and Methods

Sixty populations of white clover were collected from various altitudes in Himachal Pradesh and seventeen exotic lines were procured from IGER, UK. All the collections were raised in experimental plots measuring 2m x 1m in Randomised Block Design in three replicates during 1999-2000. The data were recorded on twenty one morphological characters (Table 1). The observations were made on five mature plants each of three replicates of all populations. For cyanogenesis, picrate paper test was used. The herbage was oven dried at 60° C to calculate dry matter yield. The collections were grouped on the basis of morphological data.

Results and Discussion

The range, mean values, S.D. and CV% for the twenty one characters recorded, are given in Table 1. The plant height ranged from 1.65 cm to 13.9 cm. Most of the local collections and exotic lines were dwarf- or medium-sized. Only six collections, namely RRCP-L-53, RRCP-L-55, RRCP-L-56, RRCP-L-111, RRCP-L-117 and RRCP-L-123 were classified as tall having height more than 10 cm. Five collections (RRCP-L-5, RRCP-L-10, RRCP-L-11, RRCP-L-12, RRCP-L-19) were identified as spreading. The number of stolon branches and growing points ranged between 2.1-11.62 and 2.5-11.0 respectively. The number of roots per stolon branch ranged from

Table 1. Morphological variability in white clover collections

Character	Range	Mean±S.D.	CV%
Plant height (cm)	1.65-13.90	5.91±2.71	45.67
Mid leaflet (mm)	3.20-8.60	4.63±2.37	51.33
Petiole length (cm)	1.28-13.60	5.48±2.66	48.45
Stolon branch (cm)	2.08-11.62	6.39±1.63	25.54
Stolon diameter (mm)	0.10-0.38	0.22±0.05	22.12
No. of stolon branches	2.00-16.00	6.35±2.05	32.23
Nodes/stolon branch	1.40-8.80	4.98±1.47	29.54
No. of growing points	2.50-11.00	5.89±1.71	29.03
Root length(cm)	2.53-13.87	6.63±3.09	46.64
No. of roots	3.00-46.00	11.02±7.57	68.72
Nodules/root	1.53-17.00	4.98±2.60	52.18
Heads/plant	27.00-153.00	90.85±33.24	36.59
Floret/head	17.50-62.00	41.72±10.52	25.21
Seed/floret	0.00-3.80	2.26±0.84	36.96
Seed/head	0.00-191.00	93.47±47.84	51.19
1000-seed weight (g)	0.53-0.56	0.54±0.01	1.11
Peduncle length (cm)	2.56-15.30	8.52±3.18	37.35
Peduncle diameter (mm)	0.10-0.20	0.12±0.03	26.45
Seed yield (t/ha)	0.05-0.80	0.22±0.14	64.22
Herbage (t/ha)	0.10-78.75	7.88±6.38	80.96
Cyanogenesis	0.00-4.83	1.65±1.51	91.92

3 to 46 and nodules per root from 1.43 to 17.0. Only three collections namely, RRCP-L-11, RRCP-L-15 and RRCP-L-65 had more than 10 nodules/root. There were two peaks for flowering in white clover. The first one was from March to May and second one from July to August. The populations came into flowering in March and continued till May. Fourteen populations were classified as early bloomers. All exotic and eight local populations were late flowering where flowering started during last week of April or first week of May. All the collections were self-incompatible. The seed set per floret ranged from 0 to 3.8. Only five populations i.e. RRCP-L-10, RRCP-L-17, RRCP-L-45, RRCP-L-52 and RRCP-L-58 set more than three seeds per floret.

Considerable variation was recorded for presence or absence of crescent in leaflets and cyanogenesis score. Thity-seven populations were classified as acyanogenic, having cyanogenesis score less than one, while 15 populations were classified as cyanogenic having cyanogenesis score more than three.

The present study reveals that white clover exhibits considerable variability for most of the morphological traits. Phenotypic plasticity is well known in white clover; High levels of genetic variability are typically detected both within and between white clover populations for most traits (Caradus *et al.*, 1989; Williams, 1987). Based on overall morphology and quality, the populations were grouped into eight groups (Table 2). Group I consisted of two populations where plants were large leaved, prostrate with lesser growing points and smaller stolons, cyanogenic, low in yield and nodulation and average in flower abundance. Group II had medium leaved, erect, persistent, cyanogenic, medium in yield and nodulation, late and average flowering. Group III consisted of medium leaved, erect, persistent, acyanogenic, medium in yield and nodulation, late and abundant flowering. Group IV consisted of medium leaved, prostrate, non-persistent, acyanogenic, medium in yield but low in nodulation, late and average flowering. Group V had small leaved, prostrate, persistent, acyanogenic, medium in yield and nodulation and abundant flowering. Group VI was similar to Group V except the populations had high incidence of cyanogenesis and average flowering. Group VII consisted of small leaved, prostrate, non-persistent, acyanogenic, medium in yield and less flowering. Group VIII differed from Group VII in having cyanogenic populations and abundant flowering. Groups III, V and VII had 30, 15 and 14 populations respectively.

Table 2. Grouping of white clover collections

Group	Characteristics	No. of populations
I	Large leaved, prostrate, non-persistent, cyanogenic, low in yield and nodulation and average in flower abundance	2
II	Medium leaved, erect, persistent, cyanogenic, medium in yield and nodulation, late and average flowering.	2
III	Medium leaved, erect, persistent, acyanogenic, medium in yield and nodulation, late and abundant flowering	30
IV	Medium leaved, prostrate, non-persistent, acyanogenic, medium in yield but low in nodulation, late and average flowering.	3
V	Small leaved, prostrate, persistent, acyanogenic, medium in yield and nodulation, abundant flowering.	15
VI	Small leaved, prostrate, persistent, cyanogenic, medium in yield and nodulation, average flowering.	3
VII	Small leaved, prostrate, non-persistent, acyanogenic, medium in yield and less flowering.	14
VIII	Small leaved, prostrate, non-persistent, cyanogenic, medium in yield and abundant flowering.	8

The uncertainty of persistence is the most important problem in white clover. The white clover types which are strongly stoloniferous will have better potential persistence than less stoloniferous types (Davies and Young, 1967). At the same time, it is considered that the prostrate small leaved varieties are less vulnerable to loss of their tap root system and therefore, their persistence is enhanced (Frame and Newbould, 1986). However the ideotype of white clover should bear large leaves as well as they should be persistent. The present

Table 3. Promising white clover collections

Character	Collection no.
Plant height	RRCP-L-123
Large leaves	RRCP-L-119
Long stolons	RRCP-L-17
Nodes/stolon branch	RRCP-L-11, RRCP-L-12
Growing points	RRCP-L-12
Nodules/root	RRCP-L-15
Flowering abundance	RRCP-L-19, RRCP-L-62
Seed/floret	RRCP-L-10, RRCP-L-52
Herbage yield	RRCP-L-23
Seed yield	RRCP-L-21
Acyanogenic	RRCP-L-11, RRCP-L-14, RRCP-L-17, RRCP-L-28, RRCP-L-41, RRCP-L-48, RRCP-L-49, RRCP-L-52, RRCP-L-59

study helped in identification of populations bearing particular desirable traits (Table 3) for improvement of white clover.

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