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PHENOTYPIC STABILITY OF HERBAGE YIELD AND OTHER CHARACTERS IN LUCERNE

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Eleven genotypes of lucerne (*Medicago sativa* L.) were evaluated with respect to herbage yield and its components for three years. The data pertaining to 17 cuts were analysed considering individual cuts as environments. Presence of genotype-environment interaction was revealed for the traits green forage yeield, dry matter yield, plant height and leafiness percentage. Mean performance of varieties could be predicted across the environments. Variety Anand-2 was above average in performance for green forage yield, dry matter yield and plant height, below average in response and stable for these characters. It was highly stable for leafiness but unstable for number of tillers. The recommended variety T-9 was very poor in performance, below average in response and stable for green forage and dry matter yield only.

A number of high yielding varieties of lucerne are available in the country but the information regarding their phenotypic stability in different cuts and/or under perennial conditions is not available. The present study, therefore, was undertaken to know the differential response of lucerne genotypes, if any, to different cuts (environment) for a period of three years with respect to herbage yield and its components.

MATERIAL AND METHODS

The material for the present studies consisted of eleven genotypes of lucerne i.e. Anand-2 (Gujarat Lucerne-1), SS-627, Atir, 71-18, 71-28, 71-6, T-9, FS-85 L.L. Composite-2, L.L. Composite-3 and Kutchi. These genotypes were grown in a four replicated randomized block design in a gross plot size of 4 x 3 m² during 1978-80. Seed material was sown at the rate of 15 kg/ha in four metre long rows keeping 25 cm distance between rows. A net plot size of 3.5x2.5 m² was harvested and observations recorded in each cut for the traits green forage yield, dry matter yield, plant height, number of tillers per metre row length and leafiness percentage. Seventeen cuts were completed till May, 1980. Each cut was considered as an environment. Therefore, the experiment consisted of seventeen environments. Statistical analysis was done according to the method proposed by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

The mean squares due to genotype and the environments when tested against the pooled error and pooled deviation showed significant differences suggesting the presence of variation among genotypes as well as environments (Table-1). The mean squares due to genotype-environment interac-

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tions for the traits viz., green forage yield, 'dry matter yield', 'plant height' and leafiness percentage were highly significant when tested against pooled deviation thereby suggesting that the genotypes interacted considerably with environments in the expression of these four traits. High significant differences due to environments (linear) for all the characters indicated differences between environments and their considerable influence on all the five traits. Linear component of genotype-environment interaction was highly significant for the characters 'green forage yield', 'plant height' 'number of tillers' and 'leafiness' when tested against pooled error. Number of tillers and leafiness also showed significant differences when tested against pooled deviation. These data suggested linearity of genotype-environment interactions for these traits. Significant pooled deviation for the characters 'green forage yield', 'dry matter yield', 'plant height' and 'leafiness' suggested that the genotypes differed considerably with respect to their stability for these characters.

Differences among varieties in a total of seventeen cuts with respect to green forage and dry matter yield showed highly significant differences. Green forage yield varied from 859.08 q/ha for Kutchi to 1397.55 q/ha for Anand-2. The most popular and the recommended check variety, T-9 gave 936.4 q/ha. Considering dry matter, it ranged from 160.59 q/ha for Kutchi to 278.63 q/ha for Anand-2. The check variety T-9 gave 188.14 q/ha. In both cases the check variety gave significantly less green forage and dry matter yield indicating the superiority of Anand-2.

Eberhart and Russell (1966) suggested that an ideal variety is one which has the highest mean yield over a broad range of environment, a regression coefficient of one and deviation mean square of 0. According to Finlay and Wilkinson (1963) linear regression is a measure of stability but Breese (1969) and Paroda and Hays (1971) showed that the linear regression is simply a measure of response of a particular genotype while the deviation mean square should be considered as the measure of stability. Therefore due emphasis should be given to all the three measures of stability. Of the eleven genotypes tested, Anand-2 gave the highest yield of green forage yield below average in response and some what stable. Varieties SS-627 and 71-18 gave above average yield and response and were highly stable while L.L. Composite-2 was above average in performance, below average in response and stable. Check variety T-9 was poor in performance below average in response andsome what stable while Kutchi was the poorest in performance, above average in response and the most unstable. These data suggested that T-9 is not a superior perennial type as compared to varieties like Anand-2 and SS-627.

Considering the character dry matter production, variety Anand-2 was significantly superior over others and gave the best performance, below average response and fairly stable. T-9 was below average in performance and

response and fairly stable. Kutchi local was the poorest in performance, above average in response and highly unstable.

Variety Anand-2 was the tallest, average in response and unstable. Variety T-9 was the shotest, below average in response and highly unstable. SS-627 followed by FS-85 produced the maximum number of tillers, were below average in response and stable. Anand-2, 71-18, FS-85, L.L.Composite-3 and Kutchi local gave significant b. values. These results suggested that most of the genotype-enviroment interaction could be attributed to linear component. This was in conformity with the pooled analysis given in table-1.

The b values for leafiness were significant for three varieties and $S^{-2}d$ for five indicating the involvement of both linear and non linear portion of genotype - environment interaction. Variety T-9 showed the best performance, above average response and fair stability. Anand-2 was above average in performance below average in response and highly stable.

These data showed that stability in herbage yield appears to be related to the stability for its components. The were stability of plant height and leafiness responsible to provide stability and high yield to the variety Anand-2 and tiller numbers to SS-627 while lower yield in T-9 is mainly due to highly unstable nature of its plant height and tiller numbers. Liang and Riedl (1964) observed that plant height, number of leaves, number of internodes and number of stems were positively correlated.

From these data it can be concluded that the variety Anand-2 should be preferred which possesses all the good qualities to give high yield under perennial conditions as compared to other varieties. Genotypes having stability of component characters like Anand-2 and Atir for plant height, SS-627 and Atir for tillers, Anand-2 Kutchi for leafiness should be utilized by the forage breeders for evolving high yielding and stable varieties of lucerne in their future breeding programme.

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Table I Pooled analysis of variance for forage yield and its components in lucerne (*Medicago sativa L.*)

Source of variances	d. f.	Mean squares				
		Green forage yield	Dry matter yield	Plant height	No. of tillers	Leafiness percentage
Genotypes (G)	10	10.46**++	0.47**++	408.50**++	1788.45**++	108.52**++
Environments (ENV)	16	137.36**++	3.27**++	3009.98**++	9173.20**++	433.68**++
G x ENV	160	0.88**	0.04**	32.00**	140.21	24.45**+
ENV + (G x ENV)	176	13.28**++	0.33**++	362.13**++	961.39**++	61.53**++
ENV (linear)	1	2197.87**++	52.36**++	48155.45**++	146840.32**++	6938.8**++
G x ENV (linear)	10	1.41**	0.02	40.63**	513.02**+	30.85**++
Pooled deviation	165	0.76	0.03**	28.0**	113.91	21.96*
Pooled error	561	0.02	0.02	8.85	278.30	11.22

* P = 0.05, ** P = 0.01 (With pooled error).

\+ P = 0.05, ++ P = 0.01 (With pooled deviation)

Table II Estimates of stability parameters of different genotypes of lucerne

Genotypes	Green forage yield			Dry matter yield			Plant height			No. of tillers			Leafiness		
	X	b	S^2d	X	b	S^2d	X	b	S^2d	X	b	S^2d	X	b	S^2d
Anand-2	82.2	0.91	1.46	16.3	0.93	0.05	70.8	0.98	15.68	68.2	0.63**	132.94	49.6	0.81*	2.55
SS-627	73.7	1.04	0.15	14.6	1.01	-0.01	68.7	1.01	28.70	84.7	0.92	6.69	50.7	0.87	29.53**
Atir	74.7	0.93	0.49	15.0	0.96	0.01	66.7	0.82*	5.89	75.1	0.87	9.23	47.5	1.03	36.01**
71-18	69.3	1.07	0.03	13.5	1.07	-0.01	66.4	1.05*	10.03	73.3	1.01	-13.58	50.0	0.91	10.32
71-28	64.1	1.07	0.24	12.7	1.07	0.00	62.4	1.04	17.31	80.4	1.24*	72.07	52.3	1.31	18.94
71-6	65.2	1.07	0.14	12.8	1.07	-0.01	64.9	1.13	19.67	65.0	0.97	52.62	47.5	0.80	23.85
T-9	55.0	0.91	1.30	11.0	0.89	0.04	52.2	0.91	38.62	74.9	1.21	174.03	54.0	1.35	10.73
FS-85	64.7	0.90	0.46	13.0	0.91	0.00	67.4	0.89	10.70	72.9	0.77**	26.16	47.6	0.97	24.24**
LL Composite-2	73.0	0.94	0.50	14.6	0.91	0.01	58.9	0.98	21.12	82.7	0.99	26.23	52.1	1.35	33.37
LL Composite-3	66.1	1.02	0.27	13.2	1.06	0.00	64.6	1.11	19.09	75.3	1.14**	24.62	47.2	0.66*	8.94
Kutchi	50.5	1.14	3.11*	9.4	1.10	0.12**	62.7	1.08	30.40	47.2	1.25*	103.03	46.2	0.71*	6.98
Average	67.0	—	—	13.3	—	—	64.20	—	—	72.7	—	—	49.5	—	—
C. D. at 5%	4.98	—	—	0.98	—	—	2.00	—	—	7.37	—	—	3.25	—	—

* P = 0.05, ** P = 0.01.