THE ASSOCIATION OF MEASURABLE VARIABLES WITH PLANT YIELD IN LADINO CLOVER

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INTRODUCTION

Ladino clover is one of the most important forage legumes in the United States. Many are the characteristics of this plant which led to its rapid rise and acceptance by livestock farmers. As a forage legume, Ladino is widely adapted to different soil and climatic conditions. This broad adaptation makes it a common and valuable component of mixtures in irrigated pastures. Although its growth and development are favored by a temperate climate and moist fertile soils, it will also grow on poorly drained and mildly acid soils. It is especially valuable on shallow soils because of the shallow root system. This characteristic, however, necessitates more frequent irrigation to maintain the stand. It also possesses a perennial habit of growth and often establishes itself by natural reseeding. It is nutritious and palatable and as a pasture crop is highly productive. It recovers rapidly after grazing or mowing and is considered valuable for pasture, hay and seed production (3, p. 228, 230).

Forage yield is a complex character determined by the actions and interaction of many variables. The breeder of forages is in need of information relative to the degree of association that exists between plant yield and other measurable variables.

The data reported herein, were collected from a space-planted, replicated clonal nursery of ten genotypes of Ladino clover. The objectives of the study were (1) to determine differences between genotypes in respect to yield and other measurable variables, (2) to determine how much of the total variation observed in each character was due to the genetic constitution of the plant population, (3) to determine paths of relationships among measurable variables and yield, and (4) to derive a partial-regression predictive equation for yield based on certain associated variables.

REVIEW OF LITERATURE

Ahlgren and Sprague (2, p. 56), in surveying the variability of white clover, measured the following characteristics: spread of plant (length x width), leafiness, number of stolons, length of internode, height of petiole, height of flowering stalk, date of blooming, leaf color, water mark, length of the middle leaflet and width of the middle leaflet. A high degree of variability was found in all morphological and physiological characters studied in both the native and commercial strains. The authors concluded that the variation in characters was due primarily to heredity, since the environmental conditions were similar. The mean value for the characters studied showed that the Ladino and Kent strains had the greatest range in type. It was also found that a rapid spreading ability was associated with an increased size of all plant organs and rapid spreading plants usually did not form a dense mat of growth. This was evidenced by the reduced number of leaves per unit area found in plants of this type (2, p. 43).

A technique for evaluating individual plants of white clover was tested by Atwood and Garber (4, p. 1). The plants used in this experiment varied in such characters as spread, height, density, size of plant parts, and extent of flowering. It was concluded that the better sods were formed by the taller, more spreading, and more densely growing plants. Poor sods were formed by non-spreading types, which had extremely short internodal growth; by very prostrate plants which appeared to be smothered out by grass, and by open growing clones which maintained this habit in sod. Growth habit of individually spaced plants, however, was not closely correlated with performance in sod.

Dessureaux (11, p. 131) compared non-selected populations of Ladino and wild white clovers and found a considerable variation in such vegetative characters as height, thickness, spread of the plant and size of the leaves. Foliage density was generally associated with the type of growth.

Based on greenhouse studies, Knight (20, p. 50) found that the total number of stolons, stolon diameter score, vigor in the greenhouse after flowering, and disease score, for one year of the experiments, were significantly correlated with winter survival in the field. Resistant clones and progenies produced a large number of stolons having relatively small diameters.

Ratings of Ladino clover spaced plants for seed setting, vigor density and spread in the autumn of the first year were highly indicative of the performance of these plants in the second year, as found by Brigham and Wilsie (6, p.127). Actual forage yields were found to be closely related to scores for spread, vigor, and density, suggesting that an overall rating for vegetative growth could be used as a basis for selection in spaced plants.

Carnanan and Brown (10, p. 48), reported leaflet length and width to be inherited quantitatively. There was an indication that certain genes conditioning leaflet size also had an effect on length and width of leaflets.

Jackobs and Hittle (18, p. 51), studying the frequencies of various plant types for different certified Ladino seed lots, found that Italian Ladino had a greater mean petiole diameter than the other groups compared.

In studying the yield characters of white clover in West Germany, Lehle (21, p. 103) found that leaf size and stalk length were positively correlated. There was also a correlation between leaf weight and stalk weight. The yield from the large leaved forms had a greater proportion of stalk than was found in the yield of small leaved forms. Also, when the crops were cut at the same height, there was a relatively greater loss of stalk from the small leaved crops. Observations were made on changes in leaf size occurring during growth and it was found that the relative differences in leaf size between strains were maintained throughout the vegetative period.

Owens (28, p. 51) studied the performance of six component clonal lines of white clover, the synthetic 1 from them and clones from the synthetic 1. The component clonal lines indicated significant difference when compared in the polycross nursery for yields of forage, stolon spread, yield of seeds and frequency of seedheads in the blossom stage.

Components of forage yield

Among the several statistical approaches used to estimate compoments of forage yield, path coefficient analysis has been one of the most useful. The theory has been discussed in detail by Li (22, p. 152-176). It has been defined as a simple standardized partial regression coefficient and, as such, measures the direct influence of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects. The use of the method requires a cause and an effect situation among the variables, and the experimenter must assign direction in the causal system based upon *a priori* grounds or experimental evidence (13, p. 516; 30, p. 153).

The path coefficient, so defined, possesses many properties which make it useful in statistical analyses. Being a type of regression coefficient, it is directional (e.g., from x to y), may be positive or negative and may be greater or less than unity. Being without a physical unit, it resembles a correlation coefficient. It reduces to an ordinary correlation coefficient under certain simple conditions (23, p. 193).

The separation of a correlation coefficient into various components is one of the chief accomplishments of the method of path coefficients. Analogous to the "analysis of variance", the path method may be called "the analysis of correlations."

The information concerning the use of the method in agricultural research is rather limited. Frakes (16, p. 31) used it to calculate components of forage yield in alfalfa. Dewey and Lu (13, p. 516) used it in the analysis of components of crested wheatgrass seed production.

<u>Heritability estimates</u>

Since many economic traits in plants have a quantitative pattern of inheritance, the plant breeder must have a tool which permits not only an accurate interpretation of the results, but at the same time gives an indication of the future performance of the material with which he is working.

In reviewing the use of heritability estimates in plant breeding, Warner (32, p. 427) wrote:

> "The usefulness of estimates of heritability as a practical tool of the plant breeder, depends on several factors. In the first place, estimates of heritability provide information on the relative practicability of selection. High heritability in the F_2 indicates that effective selection on an individual plant is possible. A plant breeder, faced with a problem in an unfamiliar crop or on a character about which little is known, might find some heritability studies useful in order to attack the problem more intelligently."

Several definitions of heritability are found in the literature. Lush (25, p. 357) considers both broad and narrow sense heritability estimates. Heritability in the broad sense estimate corresponds to the ratio of the total genetic variance (additive, dominant and epistatic) to the total variance (total genetic plus environment). Narrow sense heritability refers to the ratio of the additive genetic variance to the total variance.

Poehlman (29, p. 33-34) defines heritability as the degree to which the variability of a quantitative character may be transmitted to the progeny. Or, in other words, as the proportion of the total variation in a progeny that is the result of genetic factors and may be transmitted. On the other hand, Sinnott and Dobzhansky (31, p. 275) state that the greater the heritability, the greater the average resemblance between the parents and the progeny. The greater the environmental component of the observed phenotypic variation, the less the correlation between the fruits of parents and children. Therefore, heritabilities determined under one set of conditions may not be applicable to another (5, p. 259).

Warner (32, p. 427) presented a method of estimating heritability from the variance of three segregating populations, the F_2 and the summed back crosses to each parent.

Total genetic variance was calculated from the variance components in tall fescue by Burton and DeVane (9, p. 481). This genetic variance was used to calculate broad sense heritability estimates for seed yield, forage yield and disease resistance.

Kneebone (19, p. 461) estimated heritability of plant height and plant diameter in sand bluestem using four sets of information: analysis of variance among parent clones, analysis of variance among their open pollinated progenies, parent progeny correlations and regressions, and interannual and interlocations correlations.

The heritability of dry matter content and protein in tall fescue were calculated by Frakes (15, p. 27-28; 35-36), who also studied the action (16, p. 17) of clipping treatments and stage of growth on the heritability of several characters in alfalfa.

Estimates of heritability of family differences in relation to *Pseudopeziza medicaginis* resistance ranged from 79.26 to 89.62 in two unrelated alfalfa populations, as calculated by Adams and Semeniuk (1, p. 679).

METHODS AND MATERIALS

The plant material used in the experiment represented 10 genotypes of Ladino clover selected June 6, 1960, from a discarded foundation seed field. Each genotype was increased vegetatively by cuttings. A commercial mixture of indol butyric, indol acetic and napthalene acetic acid (Hormodin) was used to initiate root development on the vegetative cuttings. The cuttings were rooted in a sterile media (Dantore) and established in six inch pots in the greenhouse.

The plants were removed from the pots and established in the field nursery on August 1, 1960. Each genotype was represented once in each of seven replications of a randomized block design. A row of border plants was established around the nursery.

The experiment was irrigated twice each week for two hours, which resulted in a minimum water penetration in the soil of two inches. Insects and slugs were controlled by periodic treatment with methoxychlore and slug bait.

Data were collected at three different dates representing different stages in the process of development of the plants. The first notes were taken on September 2 and 3 on the following characteristics: length (cm.) of five petioles taken at random; length (cm.) of flowering stalks; number of flowers per clone; length (cm.) and width (cm.)

of the middle leaflet; spread of the plant as estimated by the product of plant length (cm.) and plant width (cm.); total number of stolons; length (cm.) of the longest stolon; number of internodes in the longest stolon, which served as the basis for calculating the average length of internode in the longest stolon; stem diameter (cm.) in three different parts of the stolon; and natural height (cm.).

The second set of data was taken on September 13-15, 1960, and it included the same characters listed above, plus an evaluation of leafiness. Leafiness was estimated by placing a 10 x 10 cm. frame over the most leafy part of the plant and counting the number of leaves in the exposed 100 square cm. area. Only those leaves having all leaflets on the major portion of the three leaflets in the square were considered. With the exception of leafiness, the same data were collected again on October 1 and 2.

The plants were individually harvested by hand on October 8, 1960. Each plant was tagged and kept temporarily in polyethylene bags before weighing, in order to reduce loss of moisture. The plants were weighed to the nearest gram on a Toledo scale. The samples were oven dried at 160° F. for three days and weighed again in order to determine the dry weight.

Twenty days later, October 29, 1960, recovery data were collected. This was done by measuring the spread of the plant (width x length), the natural plant height and by visual ratings from 0, (no recovery), to 9, (most recovery).

Statistical Analysis

All data were analyzed by the analysis of variance procedures for a randomized block. The expected mean squares were used to arrive at the heritability estimates on a single plant basis. On a single plot basis the broad sense heritability estimates (H) becomes:

$$H = \frac{Vg}{Vg + Ve}$$

where Vg = total genetic variance and Ve = environmental variance.

The genetic coefficients of variation (Gcv) were computed for each character according to the following formula:

$$Gcv = \frac{(100) \times \sqrt{Vg}}{\overline{X}},$$

where $\overline{x}$ = the grand mean of the plant population.

The heritability estimates (H) were used in association with the computed selection differential (s) with 20 percent selection pressure to arrive at estimates of the genetic potential (S) for each character. The difference between the mean of the selects and the mean of the population was used as the selection differential. The product of heritability estimate and the selection differential was used as the genetic potential in units of measure. This was also expressed in percent of the population mean.

In order to study the relationship between dry matter yield and the measurable variables the data were sent to the Western Data Processing Center at the University of California. The measurable variables included all the data collected in the three ratings plus the dry matter percentage. The calculations included all possible simple correlations between the variables and yield, partial and multiple regression coefficients, and "t" values.

RESULTS AND DISCUSSION

Dry Matter

The average dry matter yield for the ten genotypes is presented in Table 1. Significant differences between genotypes were observed, with clones 1, 9 and 10 yielding significantly better than the other genotypes. Clones 2 and 8 performed poorly thoughout the experiment. This poor performance was observed at the offset of the experiment when plants were being increased in the greenhouse.

The heritability estimate for dry matter yield was 40 percent, indicating that 40 percent of the differences observed between genotypes was due to the genetic constitution of the plants being studied.

The product of the heritability estimate and the selection differential gave a genetic potential above the mean of 11.00 grams which represents 16.91 percent of the mean.

Table 1. DRY MATTER YIELD IN GRAMS PER PLANT, AVERAGE OF SEVEN REPLICATIONS[1], OCTOBER 8, 1960.

Clone Number	Yield in Grams
1	97.43[a]
10	87.71[a]
9	87.14[a]
3	62.57[b]
7	60.28[b]
4	59.86[b]
5	58.14[b]
6	56.57[b]
8	43.00[b]
2	42.20[b]

[1] Clones 8 and 2 represented by 6 and 5 replications, respectively.

[2] Entries within the same letter are not significantly different but are significantly different from entries not within the same letter.

Dry Matter Percentage

Average dry matter percentages are presented in Table 2. The highest average dry matter percentage was observed in clone 8 (19.33 percent) and the lowest in clone 2 (14.86 percent). This indicated no relationship between dry matter yield and dry matter percentage. The correlation coefficient between dry matter yield and dry matter percent was not significant ($r = 0.05$). Green weight was recorded after a heavy rain, and differential retention of water from clone to clone may have occurred. The low value for heritability estimate in this variable (16 percent) indicates a high environmental influence.

Table 2. DRY MATTER PERCENTAGE (D.M.P.) PER PLANT, AVERAGE OF SEVEN REPLICATIONS[1], OCTOBER 8, 1960.

Clone Number	Dry Matter
	%
1	16.36
2	14.86
3	15.31
4	15.71
5	15.48
6	18.57
7	16.06
8	19.33
9	18.46
10	17.44

[1] Clones 8 and 2 represented by 6 and 5 replications, respectively.

Length of the Petiole

Highly significant differences between genotypes were found for the length of the petiole in each one of the three ratings (Table 3). Clone 1 had the longest general average length (16.71 cm.) and clones 2 and 8 had the shortest average length (11.08 and 11.09 cm. respectively). This was also true for the first and third ratings.

The rate of growth of the petiole between the second and third ratings, as measured by its length, was twice as much as the rate of growth between the first and second ratings (Table 4). There was a slight increase from 2.045 to 2.130 in the genetic variance from the first to the second rating, followed by a large increase from 2.13 to 6.21 in the third rating. A similar pattern was observed in the broad sense heritability estimates, since the increase from the second to third rating was higher than the increase from the first to the second, although not so marked as with general mean and the variance.

The genetic potential above the mean as expressed in both centimeters and percentage, respectively, is presented in the last two columns of Table 4. The fact that the value of the expected increase augmented as the plants grew older indicates that selection for length of the petiole should be done when the plants are ready to be cut.

Table 3. AVERAGE LENGTH OF THE PETIOLE IN CENTIMETERS (CM.) AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH.

Rating[1]	CLONES[2]									
	1	2	3	4	5	6	7	8	9	10
1	12.96	8.60	10.58	11.56	11.70	8.64	12.35	8.98	11.29	12.01
2	14.86	10.98	12.95	13.05	15.19	11.26	12.79	10.65	13.08	14.63
3	22.30	13.62	16.67	17.15	17.98	15.05	18.11	13.65	16.60	12.81
Total	50.12	33.20	40.00	41.76	44.87	34.95	43.25	33.28	40.97	44.45
Average	16.71	11.08	13.33	13.92	14.96	11.65	14.42	11.09	13.66	14.82

[1] The rating numbers correspond to three different dates: 1 to September 2 and 3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

[2] Clones 8 and 2 represented by 6 and 5 replications respectively.

Table 4. GENETIC CONSTANTS CALCULATED FROM LENGTH OF THE PETIOLE DATA.

Rating[1]	Mean	Genetic Variance	Genetic Coefficient of Variability	Heritability Single Plant Basis	Genetic Potential Above the Mean	Genetic Potential in Percent of the Mean
	cm.		%	%	cm.	%
1	10.86	2.0455	13.17	35.82	.64	5.90
2	12.93	2.1298	11.29	40.49	.86	6.70
3	16.84	6.2291	14.82	58.79	1.97	11.73

[1] The rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

Length of the Middle Leaflet

The information related to the length of the middle leaflet is presented in Table 5 for the mean values and in Table 6 for several genetic constants. The differences between genotypes were statistically significant at the 1 percent level in all three ratings.

In the general average length of the middle leaflet, as well as in the second and third ratings, clone 1 ranked first (general average mean value of 3.77 cm.) and clone 8 ranked last (2.46 cm.).

The genetic variance increased from the first to the second rating (from 0.1642 to 0.1767) but decreased from the second to the third (0.1767 to 0.1611). The genetic coefficient of variability decreased from the first to the last rating, thus suggesting a tendency towards less genetic variability for the length of the middle leaflet as the plant becomes more mature. Although the heritability estimate increased from the first to the third rating, the increment increase was more pronounced in the interval between the first and the second rating. The genetic potential in percent of the mean remained rather constant in the first two ratings, from 8.65 to 8.67 percent in spite of the fact that the heritability values were different (49.53 and 60.16 respectively). This can be explained by the difference between the selection differentials from the first to the second rating. The decrease of the genetic potential in the third rating indicates that selection for length of the middle leaflet should be done before the hay stage of growth.

Table 5. AVERAGE LENGTH OF THE MIDDLE LEAFLET IN CENTIMETERS (CM.) AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH.

Rating[1]	CLONES[2]									
	1	2	3	4	5	6	7	8	9	10
1	3.34	2.37	2.95	3.52	3.11	2.73	3.01	2.11	2.94	3.16
2	3.93	2.83	3.41	3.54	3.22	3.22	3.60	2.49	3.39	3.70
3	4.04	3.28	3.81	3.89	3.58	3.30	3.62	2.77	3.50	3.84
Total	11.31	8.48	10.17	10.95	9.91	9.25	10.23	7.37	9.83	10.70
Average	3.77	2.83	3.39	3.65	3.30	3.08	3.41	2.46	3.28	3.60

[1] The rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

[2] Clones 8 and 2 represented by 6 and 5 replications respectively.

Width of the Middle Leaflet

In respect to general means (Table 7) and genetic constants, (Table 8), the pattern followed by the width of the middle leaflet is very close to the one already explained for the length of the middle leaflet, although the mean values and the genetic constants are smaller for width as compared to length. The genetic coefficient of variability (Table 8) increased from the first to the third rating in contrast with genetic coefficient of variability for the length.

The similarity between the performance of length and width of the middle leaflet may be explained by the fact that they were correlated at the 1 percent level for the three ratings.[1] Cornahan and Brown (10, p. 48), reported there are indications that certain genes conditioning leaflet size have an effect on both length and width of the leaflets.

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[1] First rating $r = 0.75$
Second rating $r = 0.66$
Third rating $r = 0.69$

Table 6. GENETIC CONSTANTS CALCULATED ON THE BASIS OF LENGTH OF THE MIDDLE LEAFLET DATA.

Rating[1]	Mean	Genetic Variance	Genetic c.v.	Broad Sense Heritability Estimates	Genetic Potential Above the Mean	Genetic Potential in Percent of the Mean
	cm.		%	%	cm.	%
1	2.92	0.1642	13.88	49.53	.25	8.65
2	3.33	0.1767	12.61	60.16	.28	8.67
3	3.54	0.1611	11.34	61.10	.25	7.24

[1] Rating numbers correspond to three different rates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

Table 7. AVERAGE WIDTH OF THE MIDDLE LEAFLET IN CENTIMETERS (CM.) AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH.

Rating[1]	CLONES[2] 1	2	3	4	5	6	7	8	9	10
1	2.58	2.04	2.45	2.28	2.21	2.15	2.21	1.95	2.06	2.32
2	3.06	2.40	2.92	2.37	2.36	2.69	2.51	2.42	2.41	2.62
3	3.47	2.77	3.44	2.92	2.91	3.04	2.77	2.62	2.82	2.96
Total	9.11	7.21	8.81	7.57	7.48	7.88	7.49	6.99	7.29	7.90
Average	3.04	2.40	2.94	2.52	2.49	2.63	2.50	2.33	2.43	2.63

[1] Rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

[2] Clones 8 and 2 represented by 6 and 5 replications respectively.

Table 8. GENETIC CONSTANTS CALCULATED ON THE BASIS OF WIDTH OF THE MIDDLE LEAFLET DATA.

Rating[1]	Mean	Genetic Variance	Genetic c.v.	Heritability on Single Plant Basis	Genetic Potential Above the Mean	Genetic Potential Percent of the Mean
	cm.		%	%	cm.	%
1	2.22	0.03119	7.95	31.07	.09	4.06
2	2.57	0.05430	9.07	50.35	.21	8.23
3	2.96	0.07307	9.13	50.85	.25	8.42

[1]Rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

Spread of the Plant

The means and the genetic constants for spread of the plant as estimated by the product between length and width are listed in Tables 9 and 10. Since spread of the plant proved to be of importance during the development of the experiment, it will be discussed in more detail in the section dedicated to the statistical interpretation of the variables associated with forage yield.

The differences between genotypes were significant at the 1 percent level in each of the three ratings. In both ratings 1 and 2, as well as in the general mean, clone 1 had the greatest value for spread and clone 8 the smallest. The increase in genetic variance from the second to the third rating was considerably higher than the increase between the first and the second rating. The same was true for petiole length (Table 10). As in the length of the middle leaflet, the coefficient of genetic variability decreased from the first to the third rating and even after recovery, indicating once more a tendency to a diminution in the genetic variability in the length of the middle leaflet and spread of the plant as the plant becomes older. The broad sense heritability estimate remained rather stable from the first to the second rating (47.21 to 47.64 percent), but increased considerably from the second to the third (47.64 to 51.52 percent).

There was a decrease in the values of the genetic potential above the mean (both in square centimeters and percentage) from the first to the third rating. This indicates that selection for good spreading ability may be done shortly after the establishment of the clonal material.

The value for expected increase in percent of the mean calculated three weeks after clipping was rather low (7.12 percent). This probably means that the expression of the spreading ability is more important in the establishment of the clones rather than the recovery after clipping. One of the reasons to support this statement is the fact that when a well established Ladino clover plant is cut the recovery is rather quick since several stolons have had to develop a new root system.

Table 9. AVERAGE SPREAD OF THE PLANT AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH AND ONE OF REGROWTH.

Rating[1]	CLONES[2]									
	1	2	3	4	5	6	7	8	9	10
1	1743	686	882	993	1207	738	1238	680	1014	1255
2	2473	1217	1453	1490	1915	1353	1852	1121	1964	2335
3	4129	2416	3338	3422	3823	2617	4145	2353	4077	4188
Total	8345	4319	5673	5905	6946	4710	7235	4154	7055	7781
Average	2732	1440	1891	1968	2315	1570	2412	1385	2352	2593
					Three weeks after clipping					
4	2467	1712	1470	2298	1910	1777	2295	1693	2204	1987

[1] Rating numbers correspond to four different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; 3 to October 1-3, 1960; and 4 to October 29, 1960.

[2] Clones 8 and 2 represented by 6 and 5 replications respectively.

Table 10. GENETIC CONSTANTS CALCULATED ON THE BASIS OF SPREAD OF THE PLANT DATA.

Rating[1]	Mean	Genetic Variance	Genetic c.v.	Heritability Single Plant Basis	Genetic Potential Above the Mean	Genetic Potential in Percent of the Mean
	$cm.^2$		%	%	$cm.^2$	%
1	1033	101923	30.90	47.21	219.99	21.30
2	1707	196372	25.96	47.64	332.05	19.45
3	3420	555975	21.80	51.52	384.34	11.24
			Three weeks after clipping			
4	1979	105945	16.45	28.59	140.95	7.12

[1] Rating numbers correspond to four different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; 3 to October 1-3, 1960; and 4 to October 29, 1960.

Natural Height

The data related with natural height and its genetic constants are listed in Table 11 and 12. The difference between genotypes for natural height were highly significant for the first and second ratings, but not for the third. The general average (Table 11) shows clone 1 to have highest value for natural height and clone 8 with the lowest, although this trend was not observed in the first and second ratings. All the genetic constants listed in Table 12 (genetic variances, genetic coefficients of variability, heritability estimates and genetic potential above the mean) increased from the first to the second rating. The estimates then decreased sharply in the third rating which suggests that natural height probably reached its maximum genetic expression between the first two ratings and then decreased to a point at which the differences were not statistically significant. It is interesting to point out that three weeks after the clipping, the heritability estimate increased considerably and so did the genetic potential above the mean.

Table 11. AVERAGE NATURAL HEIGHT IN CENTIMETERS (CM.) AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH AND ONE OF REGROWTH.

Rating[1]	CLONES[2]									
	1	2	3	4	5	6	7	8	9	10
1	11.43	8.00	9.14	9.14	11.85	7.00	12.00	6.33	10.14	10.85
2	18.71	12.60	14.71	13.14	16.28	11.14	16.28	11.50	13.86	17.14
3	27.00	20.20	20.71	22.14	23.00	16.71	21.00	16.17	20.85	22.71
Total	57.14	40.80	44.56	44.42	51.13	34.85	49.28	34.00	44.85	50.70
Average	19.05	13.60	14.85	14.81	17.04	11.62	16.43	11.33	14.95	16.90
				Three weeks after clipping						
4	14.85	8.20	9.57	11.28	11.57	10.57	9.71	7.67	11.14	12.00

[1] Rating numbers correspond to four different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; 3 to October 1-3, 1960; and 4 to October 29, 1960.

Table 12. GENETIC CONSTANTS CALCULATED ON THE BASIS OF NATURAL HEIGHT DATA.

Ratings[1]	Mean	Genetic Variance	Genetic c.v.	Heritability on Single Plant Basis	Genetic Potential Above the Mean	Genetic Potential in Percent of the Mean
	cm.		%	%	cm.	%
1	9.69	0.6844	8.53	10.07	0.19	2.03
2	14.52	5.1002	15.55	34.44	1.17	8.06
3	21.27	2.2150	7.00	10.96	0.41	1.93
			Three weeks after clipping			
4	10.65	3.5909	17.79	43.68	1.21	11.36

[1] Rating numbers correspond to four different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; 3 to October 1-3, 1960; and 4 to October 29, 1960.

Length of the Longest Stolon

The means and genetic constants, for length of the longest stolon are presented in Tables 13 and 14. The differences between genotypes for this character, as in the other characters, already considered, are also significant at the 1 percent level. The largest average mean value, however, was not in clone 1 but was in clone 4 (22.88 cm.). Clone 8 had the lowest average mean value (13.89 cm.) as shown in Table 13.

As shown in Table 14, the genetic variance steadily increased from the first to the third rating (from 0.7147 to 11.9302). The genetic coefficient of variability had a pronounced increase from the first to the second rating but then decreased in the third. The increase in the heritability estimate was steady from the first to the third rating and so was the increment of the genetic potential in percent of the mean.

Table 13. AVERAGE LENGTH OF THE LONGEST STOLON IN CENTIMETERS (CM.) AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH.

Rating[1]	CLONES[2]									
	1	2	3	4	5	6	7	8	9	10
1	17.14	13.24	13.24	16.47	14.98	9.94	18.22	10.17	15.51	19.45
2	19.93	18.64	17.53	22.77	20.28	18.41	22.67	13.43	21.30	24.33
3	22.37	25.58	23.38	29.42	24.78	17.74	26.24	18.06	26.88	24.07
Total	59.44	57.46	54.15	68.66	60.04	46.09	67.13	41.66	63.69	67.85
Average	19.81	19.15	18.05	22.88	20.01	15.36	22.38	13.89	21.23	22.62

[1] Rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

[2] Clones 8 and 2 represented by 6 and 5 replications, respectively.

Table 14. GENETIC CONSTANTS CALCULATED ON THE BASIS OF LENGTH OF THE LONGEST STOLON DATA.

Rating[1]	Mean	Genetic Variance	Genetic c.v.	Heritability Single Plant Basis	Genetic Potential Above the Mean	Genetic Potential in Percent of the Mean
	cm.		%	%	cm.	%
1	14.85	0.7147	5.69	24.59	0.98	6.59
2	19.43	10.8745	16.97	33.47	1.21	6.25
3	23.77	11.9302	14.53	47.67	2.09	8.78

[1] Rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

Average Length of Internode in the Longest Stolon

The average length of internode in the longest stolon was calculated by dividing the length of the longest stolon by the number of internodes in the longest stolon for each one of the plants included in the experiment. Genotype means and genetic constants are presented in Tables 15 and 16. The highest value for the general average was observed in clone 9 (2.36 cm.) and the lowest in clone 8, although this was not true for the individual ratings (Table 15).

All of the genetic constants listed in Table 16 decreased from the first to the second rating and then increased from the second to the third rating. However, the highest genetic expression for the average length of internode was manifested at the third rating.

It is important to mention that this character became difficult to measure as the plants grew older and leafier. The same stolon was not measured every time from rating to rating but rather, the one selected as longest at the time of collecting the data. It is likely, at least in the third rating, that a different stolon was measured than in ratings 1 and 2, within the same plant. This consideration is valid for both length of the longest stolon and the average length of internode.

Table 15. AVERAGE LENGTH OF INTERNODE IN THE LONGEST STOLON AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH.

Rating[1]	CLONES[2] 1	2	3	4	5	6	7	8	9	10
1	1.96	1.92	1.78	2.00	1.96	1.63	2.12	1.46	2.06	2.21
2	2.12	1.98	2.17	2.31	2.10	2.03	2.02	1.71	2.44	2.24
3	1.82	2.05	2.32	2.22	2.15	1.78	2.09	1.67	2.57	2.27
Total	5.90	5.95	6.27	6.53	6.21	5.44	6.23	4.84	7.07	6.72
Average	1.97	1.98	2.09	2.18	2.07	1.81	2.08	1.61	2.36	2.24

[1] Rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

[2] Clones 2 and 8 represented by 5 and 6 replications, respectively.

Table 16. GENETIC CONSTANTS CALCULATED ON THE BASIS OF AVERAGE LENGTH OF INTERNODE DATA.

Rating[1]	Mean	Genetic Variance	Genetic c.v.	Heritability Single Plant Basis	Genetic Potential Above the Mean	Genetic Potential in Percent of the Mean
	cm.		%	%	cm.	%
1	1.91	0.03682	10.04	24.73	.05	2.80
2	2.11	0.02560	7.58	20.42	.05	2.52
3	2.10	0.06643	12.28	51.14	.17	8.28

[1] Rating numbers correspond to three different dates: 1 to September 2-3, 1960; 2 to September 13-15, 1960; and 3 to October 1-3, 1960.

Total Number of Stolons Per Clone

The average total number of stolons per clone and the genetic constants related to this character appear in Tables 17 and 18, respectively. As in several other characters already reported, clone 1 had the largest value for number of stolons, whereas clone 8 had the lowest (Table 17). The differences between genotypes were significant at the 1 percent level in the first rating and at the 5 percent level in the second.

The genetic constants decreased from the first to the second rating (Table 18). The high genetic coefficient of variability (39.09 percent in the first rating) was probably due to differences in the capacity of the clones for establishment since the notes were taken one month after planting when some of the clones were still in the process of establishment. This character presented the same problem as in the average length of internode (Tables 15 and 16) since the number of stolons was difficult to count as the plants grew older and leafier.

Table 17. AVERAGE TOTAL NUMBER OF STOLONS PER CLONE AS RECORDED IN THREE DIFFERENT STAGES OF GROWTH.

Rating[1]	CLONES[2] 1	2	3	4	5	6	7	8	9	10
1	16.71	6.60	6.14	6.71	6.85	7.71	6.28	6.67	13.28	12.14
2	18.28	13.80	13.43	12.00	11.71	14.57	13.00	11.67	20.86	15.71
Total	34.99	20.40	19.57	18.71	18.56	22.28	19.28	18.34	34.14	27.85
Average	17.49	10.20	9.78	9.35	9.28	11.14	9.64	9.17	17.07	13.92

[1] Rating numbers correspond to two different dates: 1 to September 2-3, 1960; and 2 to September 13-15, 1960.

[2] Clones 8 and 2 represented by 6 and 5 replications respectively.

Table 18. GENETIC CONSTANTS CALCULATED ON THE BASIS OF TOTAL NUMBER OF STOLONS PER CLONE DATA.

Rating[1]	Mean	Genetic Variance	Genetic c.v.	Heritability Single Plant Basis	Genetic Potential Above the Mean	Genetic Potential in Percent of the Mean
	cm.		%	%	cm.	%
1	8.93	12.1867	39.09	47.53	2.88	32.25
2	14.34	6.3858	17.62	20.89	1.09	7.62

[1] Rating numbers correspond to two different dates: 1 to September 2-3, 1960; and 2 to September 13-15, 1960.

Recovery after Cutting

Since the ability for recovering is very important in perennial forage species, three different criteria were used in the estimation of this character. First, by measuring the spread of the plant (length x width), second, by measuring its natural height, and third, by estimating it visually using a scale from zero, no recovery, to nine, full recovery. These three different sets of data were recorded simultaneously and they are presented in Tables 9 and 10 for spread of the plant; Tables 11 and 12 for natural height, and Table 19 for visual rating.

The three sets of data are not coincident in estimating the extent of the recovery which was, in general, rather good. It is obvious that the way the clones were harvested influenced markedly the aftermath and might have accounted for highly significant differences between replications in the case of natural height. The data were taken three weeks after harvesting, when most of the clones were just entering a period of full recovery. It is reasonable to assume that the former performance of the clones in terms of natural plant height and spread might have influenced the expression of the same characteristics when the recovery data were taken. In general, the clones recovered in a pattern similar to that before clipping. Vigorous clones, such as number 1 recovered more quickly than the less vigorous, such as clones 2 and 8, as shown in Tables 9 and 19.

Table 19. AVERAGE VISUAL RATING OF THE RECOVERY OF THE CLONES AS ESTIMATED THREE WEEKS AFTER CLIPPING (OCTOBER 29, 1960).

CLONES[1]									
1	2	3	4	5	6	7	8	9	10
9.4	4.2	4.4	5.6	6.4	6.9	6.4	5.5	7.6	6.6

[1] Clones 8 and 2 represented by 6 and 5 replications, respectively.

Statistical Analysis

To carefully study the relationship between yield and 24 variables acting simultaneously, the data were sent to the Western Data Processing Center at the University of California for processing. The 24 variables included all the data collected in the three ratings plus the dry matter percentage (Table 20). The calculations included all possible simple correlations between the 24 variables and yield, 24 partial regression coefficients, 24 "t" values and a multiple correlation coefficient (R). These data also provided enough information to determine an equation suitable to predict yield.

Table 20. IDENTIFICATION OF VARIABLES USED IN MULTIPLE REGRESSION ANALYSIS.

Identification	Variables	Date Recorded
X_1	Length of the petiole	September 2-3, 1960
X_2	Length of the petiole	September 13-15, 1960
X_3	Length of the petiole	October 1-3, 1960
X_4	Length of the middle leaflet	September 2-3, 1960
X_5	Length of the middle leaflet	September 13-15, 1960
X_6	Length of the middle leaflet	October 1-3, 1960
X_7	Spread of the plant	September 2-3, 1960
X_8	Spread of the plant	September 13-15, 1960
X_9	Spread of the plant	October 1-3, 1960
X_{10}	Natural height	September 2-3, 1960
X_{11}	Natural height	September 13-15, 1960
X_{12}	Natural height	October 1-3, 1960
X_{13}	Width of the middle leaflet	September 2-3, 1960
X_{14}	Width of the middle leaflet	September 13-15, 1960
X_{15}	Width of the middle leaflet	October 1-3, 1960
X_{16}	Length of the longest stolon	September 2-3, 1960
X_{17}	Length of the longest stolon	September 13-15, 1960
X_{18}	Length of the longest stolon	October 1-3, 1960

Table 20. (continued)

Identification	Variables	Date Recorded
X_{19}	Average length of internode in the longest stolon	September 2-3, 1960
X_{20}	Average length of internode in the longest stolon	September 13-15, 1960
X_{21}	Average length of internode in the longest stolon	October 1-3, 1960
X_{22}	Number of stolons per clone	September 2-3, 1960
X_{23}	Number of stolons per clone	September 13-15, 1960
X_{24}	Dry matter percentage	October 8, 1960
X_{25}	Dry matter forage yield	October 8, 1960

The analysis of variance for the multiple linear regression is presented in Table 21. The highly significant F value ($F = 19.16$) indicates that there was an influence of the variables upon yield. It was therefore important to find out which one of the variables had an effect on yield. The answer is given in Table 22, where only four "t" values were significant (3 at the 5 percent and 1 at the 1 percent level of significance). These four "t" values correspond the following variables:

X_3 = length of the petiole as recorded in the third rating.

X_{17} = length of the longest stolon as recorded in the second rating.

X_{23} = total number of stolons per clone in the second rating.

X_{24} = dry matter percentage.

When the 24 variables acted simultaneously, only the four listed above had affected yield. The partial regression predictive equation based on these variables is:

$$Y = -124.8399 + 1.9892X_3 + 1.6592X_{17} + 1.0665X_{23} + 2.8109X_{24}$$

The multiple correlation coefficient for these four variables is R = .91109 which is very close to the one calculated for the 24 variables, R = 0.9544. This indicates high accuracy in the use of the equation to calculate predicted yield on the basis of these four variables. The predicted and observed dry matter yields are presented in Table 23. The values were calculated by means of an equation involving the 24 variables listed in in Tables 20, 22, and 23 as if acting simultaneously.

Table 21. ANALYSIS OF VARIANCE FOR THE MULTIPLE LINEAR REGRESSION OF 24 VARIABLES ON DRY MATTER YIELD IN LADINO CLOVER.

Source of Variation	D.F.	Sum of Squares	Mean Squares	F Value
Due to regression	24	46933.33	1955.55	19.16**
Deviation about regression	45	4592.62	102.06	
Total	69	51525.94		

** Significant at the 1 percent level.

Table 22. STATISTICAL CONSTANTS CALCULATED ON THE BASIS OF 24 VARIABLES ASSOCIATED WITH YIELD.

Variable[1]	Mean	Standard Deviation	Reg. Coeff.	Std. Error of Reg. Coef.	Computed T Value	Partial Corr. Coef.
1	10.86528	2.34685	- 1.73826	1.01435	-1.71367	-0.24751
2	12.93514	2.24822	- 0.57738	1.09031	-0.52955	-0.07870
3	16.83657	3.20075	1.98916	0.98095	2.02778*	0.28935
4	2.91914	0.55146	- 2.04007	5.76610	-0.35380	-0.05267
5	3.32843	0.53115	3.67984	5.80842	0.63354	0.09402
6	3.53771	0.62288	5.00639	4.68079	1.06956	0.15745
7	1032.91428	462.99860	0.01066	0.00853	1.24982	0.18316
8	1707.02856	630.67410	- 0.00311	0.00515	-0.60391	-0.08966
9	3420.42856	1043.96284	0.00361	0.00324	1.11501	0.16397
10	9.70000	2.93579	0.49005	0.72557	0.67539	0.10018
11	14.52857	3.77145	- 0.24737	0.58026	-0.42632	-0.06342
12	21.25714	4.32614	0.01113	0.58741	0.01895	0.00282
13	2.21929	0.32327	6.48938	8.09457	0.80169	0.11866
14	2.57414	0.32363	7.29127	8.56091	0.85169	0.12595
15	2.96571	0.37808	1.03786	7.62410	0.13613	0.02029
16	14.84571	5.15529	- 0.00564	0.68632	-0.00822	-0.00123
17	19.43428	5.40681	1.65923	0.69982	2.37094*	0.33324
18	23.76857	5.07571	- 0.59901	0.51191	-1.17015	-0.17184
19	1.90971	0.36925	-11.03740	6.48280	-1.70257	-0.24600
20	2.11286	0.33870	8.11202	5.37345	1.50965	0.21955
21	2.09771	0.34589	7.84281	5.18520	1.51254	0.21995
22	8.94286	5.02136	1.08416	0.61381	1.76627	0.25462
23	14.34286	5.76065	1.06653	0.43335	2.46112*	0.34443
24	16.93143	3.50493	2.81088	0.48322	5.81697**	0.65513
25	65.02857	27.32678				

[1] See Table 20 for identification of variables

* Significant at the 5 percent level.

** Significant at the 1 percent level.

Table 23. PREDICTED AND OBSERVED DRY MATTER YIELDS BASED ON EQUATION INVOLVING MEASURABLE VARIABLES DETERMINED ON DIFFERENT DATES.

Plant No.	Actual Yield	Predicted Yield	Deviation from Actual
	g.	g.	g.
1	116	110.75	5.24
2	88	108.68	-20.68
3	95	81.60	13.39
4	69	89.29	-20.29
5	137	111.56	25.43
6	109	106.71	2.28
7	68	70.99	- 2.99
8	54	48.82	5.17
9	36	39.51	- 3.51
10	16	10.25	5.74
11	87	82.59	4.40
12	18	9.35	8.64
13	42	38.47	3.52
14	26	29.40	- 3.40
15	66	67.55	- 1.55
16	66	74.24	- 8.24
17	47	44.20	2.79
18	25	25.57	- 0.57
19	68	57.24	10.75
20	73	59.03	13.96
21	93	75.92	17.07
22	48	43.10	4.89
23	77	79.99	- 2.99
24	72	68.98	3.01
25	104	82.70	21.29
26	29	32.43	- 3.43
27	49	57.26	- 8.26
28	40	41.51	- 1.51
29	39	64.07	-25.07
30	59	60.15	- 1.15
31	95	76.70	18.29
32	56	54.59	1.40
33	79	78.74	0.25
34	46	53.58	- 7.58
35	33	40.88	- 7.88
36	75	69.05	5.94
37	51	56.11	- 5.11
38	14	12.93	1.06
39	66	64.00	1.99
40	80	80.64	- 0.64

Table 23. (continued)

Plant No.	Actual Yield	Predicted Yield	Deviation from Actual
	g.	g.	g.
41	74	56.72	17.27
42	36	50.48	-14.48
43	63	60.98	2.01
44	70	85.27	-15.27
45	78	98.60	-20.60
46	77	57.48	19.51
47	72	81.68	- 9.68
48	47	66.32	-19.32
49	15	27.12	-12.12
50	41	52.30	-11.30
51	42	56.93	-14.93
52	36	33.75	2.24
53	41	43.64	- 2.64
54	39	48.39	- 9.39
55	59	55.19	3.80
56	27	37.29	-10.29
57	73	70.65	2.34
58	91	89.42	1.57
59	88	74.62	13.37
60	104	91.36	12.63
61	88	91.81	- 3.81
62	71	65.62	5.37
63	95	104.04	- 9.04
64	91	116.44	-25.44
65	64	64.41	- 0.41
66	67	57.94	9.05
67	90	81.07	8.92
68	118	108.29	9.70
69	103	86.68	16.31
70	81	77.80	3.19

In Table 24 is listed the path coefficient analysis of correlation coefficient between yield and each of four variables, length of the petiole (third rating), length of the longest stolon (second rating), total number of stolons per clone (second rating), and dry matter percent (X_3, X_{17}, X_{23}, X_{24}). Length of the petiole had the largest direct association (73 percent) with yield ($r = 0.7264$) and the largest indirect effects via the other three variables. The number of stolons per clone is next to the length of the petiole with a direct effect of 63 percent of its correlation coefficient with yield ($r = .6830$) and also ranking second in the indirect effect via the other two variables. The third place corresponds to length of the longest stolon in the second rating ($r = 0.6571$) and finally, a negative indirect association of the dry matter percentage with the variables, length of the petiole, length of the longest stolon, and total number of stolons per clone, which makes its association with yield ($r = 0.0513$) non-significant.

The multiple regression analysis also determined that the following four variables accounted for most of the variation in yield:

X_9 = spread of the plant (third rating)

X_{12} = width of the middle leaflet (first rating)

X_{22} = number of stolons per clone (first rating)

X_{24} = dry matter percentage

Table 24. PATH COEFFICIENT ANALYSIS OF CORRELATION COEFFICIENTS (r) TO DETERMINE DIRECT AND INDIRECT EFFECTS OF 4 VARIABLES ON YIELD.

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and length of the petiole (third rating)			
Direct effect	0.5327		
Indirect via length of the longest stolon		0.1083	
Indirect via number of stolons per clone		0.1860	
Indirect via dry matter percentage		0.1006	
Total (r)			0.7264
Yield and length of the longest stolon (second rating)			
Direct effect	0.2038		
Indirect via length of the petiole		0.2832	
Indirect via number of stolons per clone		0.2037	
Indirect via dry matter percentage		-0.0336	
Total (r)			0.6571

Table 24. (continued)

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and number of stolons per clone (second rating)			
Direct effect	0.4282		
Indirect via length of the petiole		0.2314	
Indirect via length of the longest stolon		0.0970	
Indirect via dry matter		-0.0736	
Total (r)			0.6830
Yield and dry matter percentage			
Direct effect	0.3299		
Indirect via length of the petiole		-0.1624	
Indirect via length		-0.0207	
Indirect via number of stolons per clone		-0.0955	
Total (r)			0.0513

Table 25. STATISTICAL DATA OF THE FOUR VARIABLES WHICH ACCOUNTED FOR MOST OF THE VARIATION IN THE MULTIPLE REGRESSION ANALYSIS.

Variables[1]	Coefficient	Standard Error of Coefficient	Standard Error of Estimate	F
X_9	0.01133	0.00201	14.3377	23.5003
X_{13}	16.96344	5.09079	11.5658	11.1034
X_{22}	2.43965	0.39143	16.5406	120.3322
X_{24}	2.26867	0.41875	12.4196	23.2940

[1] The variables represent: X_9 - spread of the plant (third rating); X_{13} - width of the middle leaflet (first rating); X_{22} - number of stolons per clone (first rating); X_{24} - dry matter percentage.

Table 26. PATH COEFFICIENT ANALYSIS OF CORRELATION COEFFICIENT (r) TO DETERMINE DIRECT AND INDIRECT EFFECTS OF FOUR VARIABLES ON YIELD IN LADINO CLOVER.

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and spread of the plant (third rating)			
Direct effect	0.4512		
Indirect via width of the middle leaflet		0.1064	
Indirect via number of stolons per clone		0.3111	
Indirect via dry matter percentage		-0.0922	
Total (r)			0.7764
Yield and width of the middle leaflet (third rating)			
Direct effect	0.2051		
Indirect via spread of the plant		0.2342	
Indirect via number of stolons per clone		0.1797	
Indirect via dry matter percentage		-0.0632	
Total (r)			0.5558

Table 26. (continued)

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and number of stolons per clone (first rating)			
Direct effect	0.4417		
Indirect via spread of the plant		0.3178	
Indirect via width of the middle leaflet		0.0835	
Indirect via dry matter percentage		-0.0438	
Total (r)			0.7992
Yield and dry matter			
Direct effect	0.2985		
Indirect via spread of the plant		-0.1393	
Indirect via width of the middle leaflet		-0.0434	
Indirect via number of stolons per clone		-0.0646	
Total (r)			0.0512

The multiple correlation coefficient for this is $R = 0.9126$ which is also very close to the one calculated for the 24 variables ($R = 0.9544$) mentioned above. The path coefficient analysis for those four variables with yield is presented in Table 26. About 58 percent of the association between the yield and the spread of the plant ($r = 0.7764$) was direct in effect, which also accounted for a large portion of the indirect effect via the other three variables (X_{13}, X_{22}, X_{24}). Fifty-five percent of the association between number of stolons per clone and yield was caused by the direct effect of the former. The indirect effect of the number of stolons per clone was also important via the other variables. This indicates that spread of the plant and number of stolons per clone had a comparable effect upon yield, although the effect of the spread of the plant was a little more pronounced. The width of the middle leaflet had a lower effect than the two variables already mentioned, and finally, the dry matter percentage had a negative indirect effect upon yield via the other three variables (X_9, X_{13}, X_{22}).

The path coefficient analysis has been used in the last two sets of comparisons (Tables 24 and 26) to analyze two sets of variables which were very important from the statistical standpoint. However, there are, among the 24 variables, others which were not only correlated with yield, but also showed a particular trend in the changes of their heritability values. Therefore, three more sets of comparisons involving variables which were outstanding during the development of the experiment are presented.

The first one deals with the variables: X_3, length of the petiole; X_9, spread of the plant; X_{12}, natural height; and X_{18}, length of the longest stolon, all four recorded at the third rating (October 1-3, 1960) before harvesting. This particular set of data was selected not only on the basis of changes in heritability estimate but also with the purpose of comparing the results with similar comparisons in other legume crops. The path coefficient analysis of the association of the four variables with yield is presented in Table 27. The direct effect of the spread of the plant upon yield constituted 75 percent of the correlation between them ($r = .7766$) and more than 50 percent of the indirect effects via the length of the petiole and the natural height. The direct effect of the association between natural height and yield was 35 percent of the correlation coefficient ($r = 0.5949$), whereas only 26 percent of the association between length of the petiole and yield was direct. The direct effect of length of the longest stolon upon yield was negative and so was the indirect effect via the variables length of the petiole, spread of the plant and natural height.

Table 27. PATH COEFFICIENT ANALYSIS OF CORRELATION COEFFICIENTS (r) TO DETERMINE DIRECT AND INDIRECT EFFECTS OF FOUR VARIABLES ON YIELD ON LADINO CLOVER.

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and length of the petiole			
Direct effect	0.1913		
Indirect via spread of the plant		0.4514	
Indirect via natural height		0.1236	
Indirect via length of the longest stolon		-0.0449	
Total (r)			0.7264
Yield and spread of the plant			
Direct effect	0.5838		
Indirect via length of the petiole		0.1479	
Indirect via natural height		0.1119	
Indirect via length of the longest stolon		-0.0670	
Total (r)			0.7766

Table 27. (continued)

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and natural height			
Direct effect	0.1998		
Indirect via length of the petiole		0.1231	
Indirect via spread of the plant		0.3270	
Indirect via length of the longest stolon		-0.0550	
Total (r)			0.5949
Yield and length of the longest stolon			
Direct effect	-0.1151		
Indirect via length of the petiole		0.0748	
Indirect via spread of the plant		0.3399	
Indirect via natural height		0.0954	
Total (r)			0.3950

The last comparison and the ones to be explained below, are not based on the assumption that those variables are independent components of yield. The main consideration is that they were associated with yield and associated among themselves. Therefore, the path coefficient analysis is used here to determine, for a particular set of variables acting simultaneously, which variable is contributing the most to variation in yield.

The variables length of the petiole, length of the middle leaflet, and spread of the plant, had an increase in the heritability estimate as the plants grew older. They were not only associated with yield but also associated with one another. Therefore, the purpose of using the path coefficient analysis for each one of the three ratings is to see the influence of the stage of growth on the direct and indirect effects of each one of the three variables upon yield. The data are presented in Table 28. The direct effect of the length of the petiole on yield was almost negligible, approximately 1 percent of the correlation in the first rating ($r = .5843$), increased slightly in the second rating ($r = 0.5991$), about 3 percent to become considerable in the third in which it contributed about 47 percent of the association ($r = 0.7254$). This variation of the direct effect of the length of the petiole seems to be reasonable if one considers that a good portion

Table 28. PATH COEFFICIENT ANALYSIS OF CORRELATION COEFFICIENTS (r) TO DETERMINE DIRECT AND INDIRECT EFFECTS OF THREE VARIABLES ON YIELD IN LADINO CLOVER ON THREE DIFFERENT DATES.

	First Rating		
Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and length of the petiole			
Direct effect	0.0088		
Indirect via length of middle leaflet		0.0951	
Indirect spread of the plant		0.4803	
Total (r)			0.5842
Yield and length of the middle leaflet			
Direct effect	0.1382		
Indirect via length of the petiole		0.0060	
Indirect via spread of the plant		0.4249	
Total (r)			0.5691
Yield and spread of the plant			
Direct effect	0.7002		
Indirect via length of petiole		0.0060	
Indirect via length of middle leaflet		0.0839	
Total (r)			0.7901

Table 28. (continued)

Characters Associated	Second Rating: Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and length of the petiole			
Direct effect	-0.0175		
Indirect via length of middle leaflet		0.1521	
Indirect spread of the plant		0.4645	
Total (r)			0.5991
Yield and length of the middle leaflet			
Direct effect	0.2473		
Indirect via length of the petiole		-0.0108	
Indirect via spread of the plant		0.4110	
Total (r)			0.6475
Yield and spread of the plant			
Direct effect	0.6466		
Indirect via length of petiole		-0.0112	
Indirect via length of middle leaflet		0.1571	
Total (r)			0.7925

Table 28. (continued)

Characters Associated	Third Rating		
	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and length of the petiole			
Direct effect	0.3474		
Indirect via length of middle leaflet		-0.0583	
Indirect spread of the plant		0.4363	
Total (r)			0.7254
Yield and length of the middle leaflet			
Direct effect	-0.0852		
Indirect via length of the petiole		0.2380	
Indirect via spread of the plant		0.3783	
Total (r)			0.5311
Yield and spread of the plant			
Direct effect	0.5642		
Indirect via length of petiole		0.2686	
Indirect via length of middle leaflet		-0.0571	
Total (r)			0.7756

of the forage yield consists of petioles. However, the experimental data available did not permit confirmation, because there was no separation of leaves and petioles at the time the clones were harvested and weighed.

The direct effect of the length of the middle leaflet on its association with yield accounted for 24 percent of the correlation coefficient in the first rating, reached its peak in the second (38 percent) and then dropped in the third (16 percent).

In all three ratings the spread of the plant constituted a sizeable portion of the correlation coefficient with yield. This trend was even more marked in the first rating in which it accounted for 89 percent, to drop to 81 percent in the second and to 72 percent in the third.

On the basis of the path coefficient analysis, it appears that the plants used most of their initial energy in lateral growth, but lateral growth decreases gradually as new roots develop on the stolons, thereby giving an opportunity for the petioles to increase their rate of growth.

The path coefficient analysis of the same three variables discussed above, plus the addition of natural height is listed in Table 29. In spite of the addition

Table 29. PATH COEFFICIENT ANALYSIS OF CORRELATION COEFFICIENTS (r) TO DETERMINE DIRECT AND INDIRECT EFFECTS OF 4 VARIABLES ON YIELD.

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and length of the petiole			
Direct effect	.2571		
Indirect via length of the middle leaflet		-.0441	
Indirect via spread of the plant		.4117	
Indirect via natural height		.1017	
Total (r)			.7264
Yield and length of the middle leaflet			
Direct effect	-.0645		
Indirect via length of the petiole		.1761	
Indirect via spread of the plant		.3571	
Indirect via natural height		.0633	
Total (r)			.5320
Yield and spread of the plant			
Direct effect	.5325		
Indirect via length of the petiole		.1988	
Indirect via length of the middle leaflet		-.0432	
Indirect via natural height		.0886	
Total (r)			.7767

Table 29. (continued)

Characters Associated	Path Coefficient	Path Coefficient X r Value	Correlation r
Yield and natural height			
Direct effect	.1580		
Indirect via length of the petiole		.1655	
Indirect via length of the middle leaflet		-.0258	
Indirect via spread of the plant		.2983	
Total (r)			.5960

of this new variable, the relative effect of the variables remained more or less the same. In fact, spread of the plant still accounted for a fairly large (68 percent) of its association with yield as well as 50 percent or more of the indirect effect via the variables length of the petiole, length of the middle leaflet and natural height. The second major direct and indirect effects were accounted for by the length of the petiole and the third by natural plant height. The length of the middle leaflet had a negative direct effect on its association with yield ($r = .5320$) and also negative indirect effect via the variables length of the petiole, spread of the plant and natural height.

The results of this study have confirmed facts already discovered by early workers. The importance of spread of the plant had already been discussed by Ahlgren and Sprague (2, p. 56) in 1940. At that time it was concluded that rapid spreading ability was associated with an increased size of all plant organs. This is true in the present study, since spread of the plant was not only positively correlated with the majority of the variables studied, but also had, in all path coefficient analyses considered, large direct and indirect effects. These authors also stated that rapidly spreading plants usually do not form a dense mat of growth, as evidenced by the reduced number of leaves per unit area found in plants of this type. They reached this conclusion on the basis of countings made by means of the same frame technique explained in the Materials and Methods. In the present study the technique was unsatisfactory due to overlapping of leaves and the inability to observe all leaves within the line of vision. Therefore, the data available do not permit confirmation or rejection of the statement.

Several of the authors (2, 4, 6, 28), who have surveyed the variability of Ladino and white clover have concluded that the differences between characteristics, such as the ones measured in this experiment, are genetically controlled. This fact also seems to be demonstrated here since, for most of the characters measured, the differences between genotypes were highly significant. However, the statistical approach used by them did not permit an estimate of the effects of environment. This seems to have been accomplished through the present study assuming that the calculation of heritability estimates on the basis of components of variance is a reliable approach.

SUMMARY AND CONCLUSIONS

From a discarded foundation seed field of Ladino clover, ten genotypes were selected and planted in a seven replication clonal trial in the Farm Crops Resident Instruction Nursery. Eleven different characteristics were measured at three different stages of growth and the data were analyzed statistically. Highly significant differences between genotypes were found for nine of the characters measured. The analysis of variance data were used to calculate broad sense heritability estimates which were interpreted as a measure of the genetic variability, rather than an index of transmissibility. The characters length of the petiole, length of the middle leaflet, spread of the plant and length of the longest stolon, had an increase in their heritability estimates as the plants grew older. The heritability estimate decreased for the characters number of internodes in the longest stolon and total number of stolons. The trend was irregular for the average length of internode in the longest stolon since its heritability estimate decreased from the first to the second rating but increased markedly from the second to the third. For the natural height the tendency was also irregular, but the heritability estimate increased from the first to the second rating and decreased from the second to the third.

The estimates of genetic potential above the mean, as expressed in both units of measure and percent of the mean, increased from the first to the third rating for the characters length of the petiole, width of the middle leaflet, and length of the longest stolon. This indicates that selection for this character would be more effective at a later stage of maturity, e.g. hay stage.

The estimates for genetic potential above the mean decreased from the first to the third rating in the spread of the plant and from the first to the second rating in the total number of stolons per clone. Therefore, selection would appear to be more effective if done shortly after the establishment of the clonal population.

For the characters length of the middle leaflet and natural height the highest value of genetic potential above the mean was recorded in the second rating. For this character, selection would be more effective if practiced prior to the hay stage of development.

The characters average length of internode and length of the longest stolon had a decrease in the values of genetic potential above the mean from the first to the second rating. This estimate, however, increased considerably from the second to the third rating thus indicating that a late stage of maturity would be more appropriate for effective selection.

Of the ten genotypes tested, the one identified as clone 1 ranked first in yield and seven other characteristics directly correlated with yield.

All the collected data were processed for multiple regression analysis of yield as related with each one of the characteristics measured in each rating. The analysis revealed that when the 24 variables acted simultaneously, only four of them influenced yield. Those variables were: length of the petiole as recorded in the third rating, length of the longest stolon and total number of stolons as recorded in the second rating, and dry matter percentage. The same calculations for multiple regression analysis shows that another four variables--spread of the plant in the third rating, width of the middle leaflet, and number of stolons per clone in the first rating, and dry matter percentage--accounted for most of the variation that occurred in the experiment.

The path coefficient analysis was used to compare four sets of four variables and three sets of three variables, all of them associated with yield. Spread of the plant, as measured by the product of width and length, was a major factor on yield, since it accounted for large direct and indirect effects upon it. However, its direct effect decreased from 89 percent in the first rating to 72 percent in the third. The direct and indirect effects of the length of the petiole increased considerably from the second to the third rating, thus suggesting that the plants used most of their energy for lateral growth during the early stages of development. However, the rapidity of the lateral growth decreased gradually, thus giving an opportunity for petiole development in the later stage of growth.

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APPENDIX

Appendix Table 1. DRY MATTER YIELD IN GRAMS PER PLANT AS RECORDED ON OCTOBER 8, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	116.00	88.00	95.00	69.00	137.00	109.00	68.00	682.00	97.43
2	54.00	36.00	16.00	87.00	18.00	42.22[1]	26.35[1]	279.57	42.20
3	66.00	66.00	47.00	25.00	68.00	73.00	93.00	438.00	62.57
4	48.00	77.00	72.00	104.00	29.00	49.00	40.00	419.00	59.86
5	39.00	59.00	95.00	56.00	79.00	46.00	33.00	407.00	58.14
6	75.00	51.00	14.00	66.00	80.00	74.00	36.00	396.00	56.57
7	63.00	70.00	78.00	77.00	72.00	47.00	15.00	422.00	60.28
8	41.00	42.00	36.00	41.00	39.00	59.00	27.14[1]	285.14	43.00
9	73.00	91.00	88.00	104.00	88.00	71.00	95.00	610.00	87.14
10	91.00	64.00	67.00	90.00	118.00	103.00	81.00	614.00	87.71
Total	666.00	644.00	608.00	719.00	728.00	673.22	514.49	4552.71	

[1] Calculated value for missing plant

Appendix Table 2. DRY MATTER PERCENTAGE PER PLANT AS RECORDED ON OCTOBER 8, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	14.00	15.80	17.10	14.50	17.60	16.40	19.10	114.50	16.36
2	15.90	14.50	14.50	13.60	15.80	17.20[1]	19.44[1]	111.44	14.86
3	12.70	13.50	12.30	12.00	13.40	18.80	24.50	107.20	15.31
4	15.00	14.40	14.70	18.80	15.90	14.00	17.20	110.00	15.71
5	17.40	13.60	13.10	12.50	19.00	17.30	15.59	108.40	15.48
6	12.80	14.50	19.70	18.90	21.40	19.80	22.90	130.00	18.57
7	17.10	15.70	16.80	16.30	15.50	15.90	15.10	112.40	16.06
8	18.40	14.30	17.60	16.40	26.00	23.30	24.03[1]	140.03	19.33
9	17.50	12.80	15.70	16.00	15.80	19.70	31.70	129.20	18.46
10	15.80	16.00	14.50	18.80	17.70	19.70	19.60	122.10	17.44
Total	156.60	145.10	156.00	157.80	178.10	182.10	209.57	1185.27	

[1] Calculated value for missing plant.

Appendix Table 3. LENGTH OF THE PETIOLE IN CENTIMETERS AS RECORDED ON SEPTEMBER 2-3, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	13.98	14.56	12.58	13.48	13.12	11.80	11.20	90.74	12.96
2	11.74	9.80	4.82	10.10	6.56	8.41[1]	8.57[1]	60.00	8.60
3	9.44	13.30	10.66	8.10	10.94	8.34	13.30	74.08	10.58
4	11.72	12.04	12.02	11.48	9.70	9.44	14.52	20.92	11.56
5	11.66	13.88	12.34	10.12	10.20	12.92	10.78	81.90	11.70
6	9.00	11.86	2.40	10.94	9.28	9.42	7.56	60.46	8.64
7	11.50	14.88	10.68	12.38	13.22	13.66	10.12	86.44	12.35
8	10.58	10.00	9.42	7.42	8.26	8.22	8.99[1]	62.89	8.98
9	9.28	12.18	11.44	10.12	13.48	10.30	12.26	79.06	11.29
10	11.10	9.06	10.28	14.00	13.70	14.58	11.36	84.08	12.01
Total	110.00	121.56	96.64	108.14	108.46	107.09	108.68	760.57	

[1] Calculated value for missing plant.

Appendix Table 4. LENGTH OF THE PETIOLE IN CENTIMETERS AS RECORDED ON SEPTEMBER 13-15, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps. / Clone	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	15.42	15.70	13.32	13.98	16.48	15.96	13.16	104.02	14.86
2	13.42	11.62	9.04	12.76	8.06	10.91[1]	11.32[1]	77.13	10.98
3	14.54	14.76	11.98	9.20	13.10	12.32	13.38	89.28	12.75
4	13.58	12.84	12.32	15.20	9.90	13.12	14.38	91.34	13.05
5	13.76	16.08	17.84	16.42	12.46	14.98	14.22	106.36	15.19
6	13.90	11.28	6.14	13.00	11.16	13.04	10.34	78.86	11.26
7	11.84	14.22	13.04	9.16	13.82	13.20	14.24	89.52	12.79
8	11.16	13.46	9.56	9.46	9.58	10.68	11.01[1]	74.91	10.65
9	13.62	14.48	14.16	12.00	12.44	10.92	13.98	91.60	13.08
10	16.28	12.66	13.42	15.94	15.18	13.14	15.82	102.44	14.63
Total	137.52	137.10	120.82	127.12	122.18	128.27	132.45	905.46	

[1] Calculated value for missing plant

Appendix Table 5. LENGTH OF THE PETIOLE IN CENTIMETERS AS RECORDED ON OCTOBER 1-3, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	x̄
1	24.30	22.30	22.90	19.30	23.80	23.40	20.10	156.10	22.30
2	13.20	12.50	12.00	18.70	11.70	12.79[1]	11.85[1]	92.74	13.62
3	17.30	19.20	17.90	12.10	19.10	15.40	15.10	116.70	16.67
4	15.00	22.10	17.90	20.10	13.50	16.00	15.50	120.10	17.15
5	17.10	20.70	18.00	18.90	18.40	17.50	15.30	125.90	17.98
6	18.00	15.90	9.50	16.30	15.70	15.70	14.30	105.40	15.05
7	18.60	20.60	15.30	19.80	18.00	17.70	16.80	126.80	18.11
8	13.30	14.60	14.10	14.30	13.00	12.60	12.02[1]	93.92	13.65
9	14.50	17.80	17.50	19.40	16.60	16.00	14.40	116.20	16.60
10	19.90	14.90	16.80	19.90	18.00	16.80	18.40	124.70	17.81
Total	171.20	180.60	161.90	178.80	167.80	163.89	154.37	1178.56	

[1] Calculated value for missing plant.

Appendix Table 6. LENGTH OF THE MIDDLE LEAFLET IN CENTIMETERS AS RECORDED ON SEPTEMBER 2-3, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	3.58	3.58	2.80	3.26	3.62	3.42	3.10	23.36	3.34
2	2.48	2.74	1.82	3.10	1.72	2.22[1]	2.26[1]	16.34	2.37
3	2.94	3.28	3.08	2.60	2.98	2.88	2.92	20.68	2.95
4	3.44	3.04	4.06	4.14	3.36	2.88	3.70	24.62	3.52
5	3.06	3.14	3.24	3.52	2.88	3.18	2.76	21.78	3.11
6	3.50	3.40	1.54	3.18	2.86	2.22	2.40	19.10	2.73
7	2.54	3.24	3.04	2.88	3.32	3.30	2.76	21.08	3.01
8	1.90	2.16	2.22	1.82	2.38	2.18	2.02[1]	14.68	2.11
9	3.38	2.78	3.16	2.60	2.80	2.36	3.48	20.56	2.94
10	3.44	2.88	3.14	2.98	3.22	3.46	3.02	22.14	3.16
Total	30.26	30.24	28.10	30.08	29.14	28.10	28.42	204.34	

[1] Calculated value for missing plant.

Appendix Table 7. LENGTH OF THE MIDDLE LEAFLET IN CENTIMETERS AS RECORDED ON SEPTEMBER 13-15, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	4.08	4.28	4.10	3.86	4.00	3.86	3.36	27.54	2.92
2	3.30	2.86	2.44	3.16	2.40	2.76[1]	2.53[1]	19.45	2.83
3	3.60	3.92	3.68	2.84	3.04	3.22	3.62	23.92	3.41
4	3.44	2.96	3.80	3.88	3.38	4.06	3.26	24.78	3.54
5	2.70	3.64	3.62	3.52	2.78	3.36	2.98	22.60	3.22
6	3.96	3.48	2.32	3.32	3.38	3.28	2.86	22.60	3.22
7	3.36	3.64	3.74	3.96	3.74	3.48	3.34	25.26	3.60
8	2.36	2.68	2.76	2.54	2.22	2.38	2.20[1]	17.14	2.49
9	3.46	3.60	3.22	3.20	3.46	3.24	3.58	23.76	3.39
10	3.82	4.04	3.76	3.66	3.38	4.20	3.08	25.94	3.70
Total	34.08	35.10	33.44	33.94	31.78	33.84	30.81	232.99	

[1] Calculated value for missing plant.

Appendix Table 8. LENGTH OF THE MIDDLE LEAFLET IN CENTIMETERS AS RECORDED ON OCTOBER 1-3, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	4.36	4.20	4.40	3.50	4.18	4.22	3.44	28.30	4.04
2	3.16	3.30	2.92	3.92	3.12	3.36[1]	2.30[1]	22.08	3.28
3	3.86	4.24	3.92	3.86	4.18	3.56	3.04	26.66	3.81
4	3.14	4.44	4.20	4.12	4.02	4.42	2.88	27.22	3.89
5	3.68	4.12	3.50	4.00	3.88	3.50	2.42	25.10	3.58
6	3.30	3.92	2.48	3.80	3.32	3.54	2.74	23.10	3.30
7	3.32	3.92	3.14	4.16	3.84	4.48	2.48	25.34	3.62
8	2.42	2.96	2.74	2.64	3.04	2.84	1.78[1]	18.42	2.77
9	3.60	3.92	3.22	3.68	3.60	3.66	2.82	24.50	3.50
10	4.26	4.46	3.40	4.22	3.74	3.88	2.96	26.92	3.84
Total	35.10	39.48	33.92	37.90	36.92	37.46	26.86	247.64	

[1] Calculated value for missing plant.

Appendix Table 9. WIDTH OF THE MIDDLE LEAFLET IN CENTIMETERS AS RECORDED ON SEPTEMBER 2-3, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	3.02	2.86	2.20	2.54	2.78	2.38	2.32	18.10	2.58
2	2.20	2.44	1.42	2.46	1.70	1.88[1]	1.87[1]	13.97	2.04
3	2.66	2.76	2.64	2.14	2.50	2.20	2.26	17.16	2.45
4	2.18	2.16	2.34	2.72	2.26	2.12	2.16	15.94	2.28
5	2.26	2.18	2.26	2.16	2.20	2.28	2.14	15.48	2.21
6	2.34	2.68	1.22	2.62	2.32	1.78	2.12	15.08	2.15
7	2.54	2.22	2.14	2.26	2.30	2.18	1.82	15.46	2.21
8	1.96	2.18	1.92	1.60	2.04	1.98	1.80[1]	13.98	1.95
9	2.14	2.24	2.10	1.88	1.90	1.78	2.36	14.40	2.06
10	2.56	2.16	2.26	2.26	2.46	2.48	2.10	16.28	2.32
Total	23.86	23.88	20.50	22.64	22.46	27.06	25.95	155.35	

[1] Calculated value for missing plant.

Appendix Table 10. WIDTH OF THE MIDDLE LEAFLET IN CENTIMETERS AS RECORDED ON SEPTEMBER 13-15. AVERAGE OF FIVE MEASUREMENTS.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	3.34	3.18	3.04	3.18	3.26	2.78	2.68	21.46	3.06
2	2.60	2.60	2.22	2.72	1.86	2.34[1]	2.26[1]	16.60	2.40
3	3.08	3.26	2.96	2.60	2.86	2.58	3.10	10.44	2.92
4	2.22	2.12	2.42	2.56	2.42	2.60	2.30	16.64	2.37
5	2.18	2.48	2.58	2.68	2.00	2.36	2.30	16.58	2.36
6	3.10	2.92	1.80	2.88	2.74	2.88	2.50	18.82	2.69
7	2.44	2.80	2.52	2.60	2.48	2.42	2.54	17.60	2.51
8	2.40	2.58	2.54	2.46	2.18	2.36	2.29[1]	16.81	2.42
9	2.40	2.38	2.22	2.44	2.56	2.46	2.44	16.90	2.41
10	2.74	2.68	2.54	2.66	2.68	2.64	2.40	18.34	2.62
Total	26.50	27.00	24.84	26.78	25.04	25.42	24.61	180.19	

[1] Calculated value for missing plant.

Appendix Table 11. WIDTH OF THE MIDDLE LEAFLET IN CENTIMETERS AS RECORDED ON OCTOBER 1-3, 1960. AVERAGE OF FIVE MEASUREMENTS.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	3.66	3.56	3.74	3.06	3.44	3.42	3.44	24.32	3.47
2	2.74	2.40	2.48	3.44	2.78	2.74[1]	2.55[1]	19.13	2.77
3	3.72	3.90	3.16	3.22	3.96	3.08	3.04	24.08	3.44
4	2.46	3.04	3.02	2.98	2.92	3.16	2.88	20.46	2.92
5	3.02	3.40	2.90	3.02	2.94	2.66	2.42	20.36	2.91
6	3.14	3.50	2.42	3.46	2.84	3.16	2.74	21.26	3.04
7	2.62	2.96	2.38	3.00	2.98	3.00	2.48	19.42	2.77
8	2.62	2.98	2.54	2.44	2.44	2.70	2.39[1]	18.11	2.62
9	2.84	2.98	2.78	2.58	2.88	2.88	2.82	19.76	2.82
10	2.94	2.86	2.82	3.14	3.00	2.98	2.96	20.70	2.96
Total	29.76	31.58	28.24	30.34	30.18	29.78	27.72	207.60	

[1] Calculated value for missing plant.

Appendix Table 12. SPREAD OF THE PLANT AS ESTIMATED BY THE PRODUCT LENGTH X WIDTH. SEPTEMBER 2-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	22.50	16.20	15.75	14.85	18.90	23.10	10.73	122.03	1743.20
2	7.50	7.83	2.38	13.86	2.72	6.64[1]	3.20	44.13[1]	685.80
3	7.92	11.10	8.40	3.91	11.20	8.70	10.50	61.73	881.85
4	10.64	14.72	8.40	12.00	7.28	4.00	7.50	69.54	993.42
5	11.40	11.52	19.35	10.50	15.54	9.00	7.20	84.51	1207.28
6	13.26	8.12	3.50	8.40	9.00	8.75	3.80	51.68	738.28
7	11.84	17.34	13.20	8.96	18.00	12.00	5.32	86.66	1238.00
8	6.90	9.52	4.56	7.20	4.80	7.80	3.17	43.95[1]	679.67
9	8.32	9.72	12.58	9.60	12.00	10.50	8.25	70.97	1013.85
10	14.70	8.40	9.00	14.00	18.00	11.20	12.54	87.84	1254.86
Total	114.98	114.47	93.97	103.28	117.44	106.69	72.21	723.04	

[1] Calculate value for missing plant.

Appendix Table 13. SPREAD OF THE PLANT AS ESTIMATED BY THE PRODUCT LENGTH X WIDTH. SEPTEMBER 13-15, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	34.65	21.00	23.50	17.60	28.20	27.90	20.25	173.10	2472.85
2	12.25	12.95	7.84	21.60	6.21	97.73[1]	95.47[1]	80.16	1217.00
3	17.10	18.90	16.72	6.50	14.62	9.90	18.00	101.74	1453.43
4	14.62	19.35	16.77	16.00	9.57	13.26	14.76	104.28	1489.71
5	9.74	18.00	22.09	22.05	21.15	14.70	16.32	134.05	1915.00
6	18.80	17.20	2.10	9.60	22.56	15.60	8.84	94.70	1352.86
7	13.68	22.50	23.50	14.19	27.00	19.80	9.00	129.67	1852.42
8	11.56	17.20	7.80	11.90	8.10	10.73	8.99[1]	76.28	1121.50
9	17.10	19.35	22.50	20.50	21.62	19.35	17.10	137.52	1964.57
10	27.50	18.45	19.60	22.09	22.50	24.48	28.80	163.42	2334.57
Total	187.00	184.90	162.37	162.03	181.53	165.49	151.60	1194.92	

[1] Calculated value for missing plant.

Appendix Table 14. SPREAD OF THE PLANT AS ESTIMATED BY THE PRODUCT LENGTH X WIDTH. OCTOBER 1-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	48.80	39.30	35.60	42.50	45.90	45.70	31.20	289.00	4128.57
2	26.30	21.60	17.50	37.50	17.90	21.50[1]	14.70[1]	157.00	2416.00
3	40.20	43.00	29.30	23.10	36.40	29.50	32.10	233.60	3337.14
4	25.50	48.80	44.40	38.30	21.70	36.60	24.30	239.60	3422.86
5	33.70	41.20	47.00	38.30	46.50	30.80	29.60	267.60	3822.86
6	37.50	30.50	10.30	27.40	26.50	29.60	21.40	183.20	2617.14
7	36.00	47.80	52.10	38.70	50.30	44.20	20.90	290.00	4142.86
8	25.80	30.50	22.40	25.40	16.70	20.40	14.50[1]	155.70	2303.33
9	36.80	41.90	40.20	46.90	47.40	35.50	36.70	285.40	4077.14
10	52.80	38.30	34.10	41.60	47.60	39.30	39.50	293.20	4188.57
Total	363.40	382.90	332.90	360.20	356.90	333.10	264.90	2394.30	

[1] Calculated value for missing plant.

Appendix Table 15. SPREAD OF THE PLANT AS MEASURED BY THE PRODUCT LENGTH X WIDTH. OCTOBER 29, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	28.50	37.20	26.70	27.00	20.90	24.10	20.90	185.30	26.47
2	22.10	17.50	8.50	27.40	10.10	12.00[1]	12.10[1]	109.70	17.12
3	20.90	29.70	15.90	5.70	10.90	8.50	11.30	102.90	14.70
4	28.50	31.00	24.50	25.80	18.10	16.50	16.50	160.90	22.98
5	19.60	21.30	25.70	19.60	17.40	13.60	16.50	133.70	19.10
6	17.60	28.40	10.10	18.50	13.60	16.50	19.70	124.40	17.77
7	18.50	31.00	38.70	18.70	20.90	17.50	15.40	160.70	22.95
8	19.60	27.10	15.40	13.50	14.30	11.70	12.70[1]	114.30	16.93
9	16.50	24.10	20.90	24.40	32.50	18.70	17.20	154.30	22.04
10	20.90	25.50	17.00	17.40	16.50	22.10	19.70	139.10	19.87
Total	212.70	272.80	203.40	198.00	175.20	161.20	162.00	1385.30	

[1] Calculated value for missing plant.

Appendix Table 16. NATURAL HEIGHT OF THE PLANT IN CENTIMETERS AS RECORDED ON SEPTEMBER 2-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	10.00	10.00	12.00	15.00	12.00	12.00	9.00	80.00	11.43
2	8.00	9.00	5.00	13.00	5.00	8.04[1]	8.90[1]	36.94	8.00
3	6.00	11.00	14.00	4.00	9.00	8.00	12.00	64.00	9.14
4	8.00	9.00	10.00	11.00	8.00	8.00	10.00	64.00	9.14
5	7.00	13.00	17.00	11.00	13.00	11.00	11.00	83.00	11.85
6	6.00	10.00	4.00	8.00	7.00	8.00	6.00	49.00	7.00
7	9.00	9.00	12.00	11.00	16.00	12.00	15.00	84.00	12.00
8	7.00	7.00	6.00	6.00	6.00	6.00	12.73[1]	50.73	6.33
9	7.00	14.00	10.00	11.00	11.00	10.00	8.00	71.00	10.14
10	6.00	9.00	12.00	11.00	13.00	13.00	12.00	76.00	10.85
Total	74.00	101.00	102.00	101.00	100.00	96.04	104.63	678.67	

[1] Calculated value for missing plant.

Appendix Table 17. NATURAL HEIGHT IN CENTIMETERS AS RECORDED ON SEPTEMBER 13-15, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	20.00	15.00	20.00	15.00	20.00	27.00	14.00	131.00	18.71
2	14.00	14.00	10.00	18.00	7.00	14.64[1]	11.29[1]	88.93	12.60
3	16.00	12.00	17.00	14.00	16.00	12.00	16.00	103.00	14.71
4	13.00	15.00	11.00	14.00	9.00	15.00	15.00	92.00	13.14
5	15.00	17.00	21.00	16.00	15.00	16.00	14.00	114.00	16.28
6	15.00	14.00	7.00	10.00	11.00	10.00	11.00	72.00	11.14
7	17.00	14.00	15.00	14.00	23.00	19.00	12.00	114.00	16.28
8	14.00	13.00	12.00	9.00	9.00	12.00	9.85[1]	78.85	11.50
9	10.00	13.00	12.00	16.00	16.00	16.00	14.00	97.00	13.86
10	22.00	15.00	17.00	17.00	12.00	23.00	14.00	120.00	17.14
Total	156.00	142.00	142.00	143.00	138.00	164.64	131.14	1016.78	

[1] Calculated value for missing plant.

Appendix Table 18. NATURAL HEIGHT IN CENTIMETERS AS RECORDED ON OCTOBER 1-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	28.00	26.00	28.00	24.00	30.00	30.00	23.00	189.00	27.00
2	24.00	20.00	15.00	27.00	15.00	21.51[1]	21.89[1]	144.40	20.20
3	21.00	22.00	19.00	17.00	22.00	18.00	26.00	145.00	20.71
4	19.00	23.00	21.00	22.00	18.00	26.00	26.00	155.00	22.14
5	20.00	23.00	30.00	20.00	28.00	21.00	19.00	161.00	23.00
6	18.00	20.00	8.00	19.00	18.00	19.00	15.00	117.00	16.71
7	20.00	28.00	18.00	20.00	20.00	22.00	19.00	147.00	21.00
8	17.00	19.00	15.00	15.00	13.00	18.00	28.42[1]	125.42	16.17
9	20.00	22.00	21.00	20.00	21.00	20.00	22.00	146.00	20.85
10	28.00	19.00	19.00	21.00	21.00	26.00	25.00	159.00	22.71
Total	215.00	222.00	194.00	205.00	206.00	221.51	225.31	1488.82	

[1] Calculated value for missing plant.

Appendix Table 19. NATURAL HEIGHT IN CENTIMETERS AS RECORDED ON OCTOBER 29, 1960.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	18.00	16.00	14.00	12.00	15.00	14.00	15.00	104.00	14.85
2	11.00	11.00	3.00	10.00	6.00	7.75[1]	8.17[1]	56.92	8.20
3	12.00	12.00	10.00	9.00	9.00	7.00	8.00	67.00	9.57
4	13.00	11.00	12.00	13.00	9.00	12.00	9.00	79.00	11.28
5	14.00	12.00	11.00	12.00	11.00	12.00	9.00	81.00	11.57
6	10.00	13.00	5.00	13.00	9.00	12.00	12.00	74.00	10.57
7	8.00	15.00	6.00	11.00	8.00	10.00	10.00	68.00	9.71
8	9.00	9.00	5.00	5.00	10.00	8.00	7.71[1]	53.71	7.67
9	11.00	9.00	10.00	16.00	12.00	9.00	11.00	78.00	11.14
10	12.00	13.00	11.00	11.00	9.00	11.00	17.00	84.00	12.00
Total	118.00	121.00	87.00	112.00	98.00	102.75	100.88	745.63	

[1] Calculated value for missing plant.

Appendix Table 20. LENGTH OF THE LONGEST STOLON IN CENTIMETERS AS RECORDED ON SEPTEMBER 2-3, 1960.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	19.70	16.00	17.10	12.10	17.00	23.00	15.10	120.00	17.14
2	20.30	12.80	10.00	15.10	8.00	14.63[1]	12.94[1]	93.77	13.24
3	10.60	16.00	12.60	3.50	14.00	15.00	21.00	92.70	13.24
4	15.00	25.50	16.20	22.30	7.30	15.50	13.50	115.30	16.47
5	15.70	9.50	19.00	15.20	20.00	7.50	16.00	104.90	14.98
6	13.00	7.00	2.00	10.20	15.10	17.00	5.30	69.60	9.94
7	18.00	21.00	18.50	15.50	25.60	17.50	11.50	127.60	18.22
8	13.00	11.10	6.50	10.40	5.50	14.50	9.57[1]	70.57	10.17
9	11.10	19.20	16.50	13.10	15.00	17.20	16.50	108.60	15.51
10	22.10	15.20	12.10	23.80	24.00	17.00	22.00	136.20	19.45
Total	158.50	153.30	130.50	141.20	151.50	160.83	143.41	1039.24	

[1] Calculated value for missing plant.

Appendix Table 21. LENGTH OF THE LONGEST STOLON IN CENTIMETERS AS RECORDED ON SEPTEMBER 13-15, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	18.50	15.20	19.50	17.00	23.00	29.00	17.30	139.50	19.93
2	25.00	18.60	13.60	23.50	12.50	18.65[1]	18.39[1]	130.24	18.64
3	16.00	22.00	16.50	10.70	16.00	15.00	26.50	122.70	17.53
4	22.20	30.00	23.50	27.50	12.00	21.70	22.50	159.40	22.77
5	20.60	18.70	25.00	19.70	23.00	15.00	20.00	142.00	20.28
6	19.30	12.00	3.80	11.50	19.00	17.50	11.60	94.70	18.41
7	22.20	23.00	28.00	22.50	27.00	20.50	15.50	158.70	32.67
8	12.10	18.50	13.90	11.10	11.50	13.50	13.18[1]	93.78	13.43
9	18.50	26.90	20.00	20.00	22.00	19.50	22.20	149.10	21.30
10	27.30	20.00	18.50	25.00	30.00	24.50	25.00	170.30	24.33
Total	201.70	204.90	182.30	188.50	196.00	194.85	192.17	1360.42	

[1] Calculated value for missing plant.

Appendix Table 22. LENGTH OF THE LONGEST STOLON IN CENTIMETERS AS RECORDED ON OCTOBER 1-3, 1960.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	23.50	25.00	25.60	18.50	23.50	21.00	19.50	156.60	22.37
2	33.00	27.50	21.60	30.20	15.60	23.30[1]	23.46[1]	174.66	25.58
3	28.00	21.00	26.40	20.30	20.00	20.00	28.00	163.70	23.38
4	28.50	37.00	31.50	30.00	23.00	29.00	27.00	206.00	29.42
5	26.50	22.30	28.00	28.00	25.20	21.50	22.00	173.50	24.78
6	24.00	17.20	9.00	18.00	20.50	20.00	15.50	124.20	17.74
7	29.50	31.00	30.20	23.00	25.00	24.00	21.00	183.70	26.24
8	20.00	22.00	18.60	16.40	15.00	16.40	16.33[1]	124.73	18.06
9	28.20	27.00	22.00	29.00	29.50	25.00	27.50	188.20	26.88
10	33.00	23.50	20.50	25.00	23.00	21.00	22.50	168.50	24.07
Total	174.20	253.50	233.40	238.40	220.30	221.20	222.79	1663.79	

[1] Calculated value for missing plant.

Appendix Table 23. NUMBER OF INTERNODES IN THE LONGEST STOLON IN CENTIMETERS AS RECORDED ON SEPTEMBER 2-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	9.00	8.00	8.00	7.00	10.00	11.00	8.00	61.00	8.71
2	9.00	7.00	7.00	6.00	5.00	7.80[1]	6.02[1]	47.82	6.80
3	7.00	7.00	7.00	3.00	8.00	8.00	3.00	43.00	6.14
4	8.00	10.00	4.00	10.00	5.00	8.00	7.00	52.00	7.43
5	9.00	5.00	10.00	7.00	12.00	5.00	8.00	56.00	8.00
6	7.00	4.00	2.00	6.00	9.00	8.00	4.00	40.00	5.71
7	9.00	10.00	7.00	8.00	11.00	9.00	6.00	60.00	8.57
8	10.00	8.00	4.00	7.00	4.00	9.00	6.07[1]	48.01	7.00
9	7.00	8.00	8.00	8.00	6.00	9.00	7.00	53.00	7.57
10	9.00	7.00	6.00	11.00	8.00	9.00	11.00	61.00	8.71
Total	84.00	74.00	63.00	73.00	78.00	83.80	66.09	518.89	

[1] Calculated value for missing plant.

Appendix Table 24. NUMBER OF INTERNODES IN THE LONGEST STOLON AS RECORDED ON SEPTEMBER 13-15, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	8.00	7.00	11.00	9.00	9.00	13.00	9.00	66.00	9.40
2	12.00	9.00	10.00	9.00	7.00	9.51[1]	8.75[1]	65.26	9.40
3	7.00	9.00	7.00	6.00	9.00	7.00	11.00	56.00	8.00
4	10.00	12.00	8.00	12.00	6.00	11.00	10.00	69.00	9.80
5	11.00	8.00	13.00	9.00	13.00	7.00	8.00	69.00	9.80
6	9.00	7.00	2.00	4.00	11.00	9.00	6.00	48.00	6.80
7	12.00	10.00	11.00	12.00	15.00	13.00	7.00	80.00	11.40
8	8.00	9.00	9.00	7.00	7.00	7.00	7.17[1]	54.17	7.80
9	9.00	12.00	7.00	8.00	9.00	7.00	10.00	62.00	8.80
10	12.00	9.00	8.00	12.00	12.00	12.00	11.00	76.00	10.80
Total	98.00	92.00	86.00	88.00	98.00	95.51	87.92	645.43	

[1] Calculated value for missing plant.

Appendix Table 25. NUMBER OF INTERNODES IN THE LONGEST STOLON AS RECORDED ON OCTOBER 1-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	13.00	13.00	14.00	11.00	14.00	11.00	12.00	88.00	25.71
2	16.00	14.00	11.00	13.00	8.00	11.42[1]	11.57[1]	84.99	12.40
3	12.00	9.00	9.00	10.00	10.00	9.00	13.00	72.00	10.28
4	12.00	20.00	15.00	12.00	9.00	15.00	12.00	95.00	13.57
5	13.00	11.00	15.00	11.00	13.00	10.00	11.00	84.00	12.00
6	12.00	11.00	6.00	9.00	12.00	11.00	7.00	68.00	9.71
7	15.00	16.00	14.00	11.00	12.00	11.00	12.00	91.00	13.00
8	12.00	15.00	11.00	9.00	8.00	11.00	10.33[1]	76.33	11.00
9	11.00	12.00	7.00	10.00	12.00	10.00	11.00	73.00	10.43
10	17.00	9.00	8.00	15.00	9.00	9.00	10.00	77.00	11.00
Total	133.00	130.00	110.00	111.00	107.00	108.42	109.90	809.32	

[1] Calculated value for missing plant.

Appendix Table 26. AVERAGE LENGTH OF INTERNODE IN THE LONGEST STOLON IN CENTIMETERS AS RECORDED ON SEPTEMBER 2-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	2.18	2.00	2.14	1.72	1.70	2.09	1.88	13.71	1.96
2	2.25	1.83	1.43	2.51	1.60	1.90[1]	1.88[1]	13.40	1.92
3	1.51	2.28	1.80	1.16	1.75	1.87	2.10	12.47	1.78
4	1.87	2.55	2.02	2.23	1.46	1.93	1.92	13.98	2.00
5	1.74	2.37	1.90	2.17	1.67	1.90	2.00	13.75	1.96
6	1.85	1.75	1.00	1.70	1.67	2.12	1.32	11.41	1.63
7	2.00	2.10	2.64	1.93	2.33	1.94	1.92	14.86	2.12
8	1.30	1.38	1.62	1.48	1.37	1.61	1.42[1]	10.18	1.46
9	1.58	2.40	2.06	1.63	2.50	1.91	2.35	14.43	2.06
10	2.45	2.17	2.01	2.16	3.00	1.70	2.00	15.49	2.21
Total	18.73	20.83	18.62	18.69	19.05	18.97	18.79	133.68	

[1] Calculated value for missing plot.

Appendix Table 27. AVERAGE LENGTH OF INTERNODE IN THE LONGEST STOLON IN CENTIMETERS AS RECORDED ON SEPTEMBER 13-15, 1960.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	2.31	2.17	1.77	1.89	2.55	2.23	1.92	14.84	2.02
2	2.08	2.07	1.36	2.61	1.78	1.43	2.01	13.84	1.98
3	2.28	2.44	2.39	1.78	1.78	2.14	2.41	15.17	2.17
4	2.22	2.50	2.99	2.29	2.00	1.97	2.25	16.17	2.31
5	1.87	2.34	1.92	2.19	1.77	2.14	2.50	14.73	2.10
6	2.14	1.71	1.90	2.87	1.73	1.94	1.93	14.22	2.03
7	1.85	2.30	2.54	1.87	1.80	1.58	2.21	14.15	2.02
8	1.51	2.05	1.54	1.58	1.64	1.93	1.75	12.00	1.71
9	2.05	2.24	2.86	2.50	2.44	2.78	2.22	17.09	2.44
10	2.27	2.22	2.31	2.08	2.50	2.04	2.27	15.69	2.24
Total	20.58	22.04	21.48	21.66	19.99	20.68	21.47	147.90	

Appendix Table 28. AVERAGE LENGTH OF INTERNODE IN THE LONGEST STOLON IN CENTIMETERS AS RECORDED ON OCTOBER 2-3, 1960.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	1.81	1.92	1.83	1.68	1.68	1.91	1.92	12.75	1.821
2	2.06	1.96	1.96	2.32	1.95	2.01[1]	2.11[1]	14.37	2.050
3	2.33	2.33	2.93	2.03	2.00	2.22	2.41	16.25	2.321
4	2.37	1.85	2.10	2.50	2.55	1.93	2.25	15.55	2.221
5	2.04	2.03	1.87	2.54	1.94	2.15	2.50	15.07	2.152
6	2.00	1.56	1.50	2.00	1.71	1.82	1.93	12.52	1.788
7	1.97	1.94	2.16	2.09	2.08	2.18	2.21	14.63	2.090
8	1.67	1.47	1.69	1.82	1.87	1.49	1.73[1]	11.74	1.670
9	2.56	2.25	3.14	2.90	2.46	2.50	2.22	18.03	2.575
10	1.94	2.61	2.56	1.67	2.55	2.33	2.27	15.93	2.275
Total	20.75	19.92	21.74	21.55	20.79	20.54	21.55	146.84	

[1] Calculated value for missing plant.

Appendix Table 29. NUMBER OF STOLONS PER CLONE AS RECORDED ON SEPTEMBER 2-3, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	18.00	21.00	15.00	15.00	18.00	20.00	10.00	117.00	16.71
2	7.00	5.00	2.00	16.00	3.00	5.62[1]	2.60[1]	41.22	6.60
3	8.00	8.00	4.00	3.00	6.00	7.00	7.00	43.00	6.14
4	6.00	11.00	7.00	9.00	2.00	8.00	4.00	47.00	6.71
5	8.00	7.00	11.00	7.00	7.00	5.00	3.00	48.00	6.85
6	12.00	6.00	3.00	7.00	14.00	8.00	4.00	54.00	7.71
7	4.00	12.00	15.00	4.00	9.00	6.00	4.00	54.00	6.28
8	8.00	10.00	3.00	9.00	3.00	7.00	2.83[1]	42.83	6.67
9	10.00	19.00	12.00	17.00	17.00	9.00	9.00	93.00	13.28
10	20.00	8.00	8.00	10.00	18.00	11.00	10.00	85.00	12.14
Total	101.00	107.00	80.00	97.00	97.00	86.62	56.43	625.05	

[1] Calculated value for missing plant.

Appendix Table 30. NUMBER OF STOLONS PER CLONE AS RECORDED ON SEPTEMBER 13-15, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	25.00	22.00	13.00	15.00	18.00	23.00	12.00	128.00	18.28
2	24.00	9.00	8.00	22.00	6.00	12.73[1]	8.58[1]	90.31	13.80
3	14.00	17.00	9.00	10.00	19.00	10.00	15.00	94.00	13.43
4	18.00	12.00	12.00	15.00	5.00	15.00	7.00	84.00	12.00
5	10.00	12.00	18.00	16.00	11.00	8.00	7.00	82.00	11.71
6	20.00	22.00	3.00	12.00	17.00	17.00	11.00	102.00	14.57
7	9.00	18.00	22.00	9.00	17.00	11.00	5.00	91.00	13.00
8	21.00	14.00	6.00	13.00	5.00	11.00	6.62[1]	76.62	11.67
9	21.00	26.00	17.00	25.00	26.00	16.00	15.00	146.00	20.86
10	19.00	13.00	12.00	14.00	21.00	18.00	13.00	110.00	15.71
Total	181.00	165.00	120.00	151.00	145.00	141.73	100.20	1003.93	

[1] Calculated value for missing plant.

Appendix Table 31. VISUAL ESTIMATES OF RECOVERY RATED FROM 1, NO RECOVERY, TO 10, FULL RECOVERY, ON OCTOBER 29, 1960.

Reps. / Clones	I	II	III	IV	V	VI	VII	Total	Ave.
1	10.00	10.00	8.00	9.00	9.00	10.00	10.00	66.00	9.43
2	5.00	6.00	2.00	5.00	3.00	3.75[1]	3.64[1]	28.39	4.20
3	8.00	7.00	4.00	2.00	4.00	2.00	4.00	31.00	4.43
4	8.00	6.00	6.00	5.00	4.00	6.00	4.00	39.00	5.57
5	7.00	7.00	7.00	8.00	5.00	5.00	6.00	45.00	6.43
6	7.00	10.00	2.00	10.00	3.00	8.00	8.00	48.00	6.86
7	3.00	9.00	7.00	8.00	6.00	7.00	5.00	45.00	6.43
8	6.00	7.00	6.00	6.00	4.00	4.00	5.02[1]	38.02	5.50
9	5.00	8.00	8.00	9.00	10.00	7.00	6.00	53.00	7.57
10	7.00	8.00	7.00	3.00	7.00	7.00	7.00	46.00	6.57
Total	66.00	78.00	57.00	65.00	55.00	59.75	58.66	439.41	

[1] Calculated value for missing plant.

Appendix Table 32. SIMPLE CORRELATION COEFFICIENTS (r) FOR TWENTY-FOUR VARIABLES[1] CORRELATED WITH DRY MATTER YIELD (GM/PLANT) IN LADINO CLOVER (n = 70), 1960.

	X_{24}	X_{23}	X_{22}	X_{21}	X_{20}	X_{19}	X_{18}	X_{17}	X_{16}
X_0	0.0512	0.6829	0.7993	0.1721	0.4609	0.5589	0.3949	0.6570	0.6780
X_1	-0.1166	0.4314	0.4550	0.1515	0.3547	0.5909	0.4585	0.6173	0.5944
X_2	-0.2210	0.4667	0.5428	0.2006	0.4477	0.5860	0.4738	0.6296	0.6175
X_3	-0.3049	0.4344	0.6454	0.0670	0.3598	0.5052	0.3900	0.5316	0.5848
X_4	-0.2065	0.3485	0.3913	0.3313	0.4802	0.4802	0.4829	0.5310	0.4355
X_5	-0.2941	0.4726	0.5225	0.2726	0.4058	0.5300	0.4355	0.5185	0.4600
X_6	-0.4446	0.3678	0.4264	0.1510	0.2547	0.4078	0.4168	0.3993	0.4005
X_7	-0.2330	0.5869	0.7459	0.0108	0.3171	0.5679	0.4176	0.6588	0.7351
X_8	-0.1766	0.6305	0.7586	0.1725	0.3843	0.5785	0.4413	0.6836	0.7113
X_9	-0.3087	0.6289	0.7043	0.2267	0.4443	0.6516	0.5823	0.7304	0.7021
X_{10}	-0.1724	0.2418	0.3105	0.2790	0.2943	0.5002	0.2458	0.5262	0.4808
X_{11}	-0.2472	0.4218	0.4922	0.0615	0.1455	0.3934	0.3991	0.5658	0.5464
X_{12}	-0.0898	0.4087	0.5197	0.0042	0.2653	0.4318	0.4777	0.6004	0.5976
X_{13}	-0.2118	0.3808	0.4069	0.0849	0.3217	0.3434	0.3174	0.3584	0.3470
X_{14}	-0.2243	0.4704	0.4668	-0.0499	0.2013	0.2262	0.1162	0.1438	0.1995
X_{15}	-0.3132	0.3609	0.3670	-0.0539	0.1940	0.2237	0.0843	0.1355	0.2029
X_{16}	-0.0177	0.4720	0.5353	0.1488	0.3367	0.7340	0.6185	0.8844	1.0000
X_{17}	-0.1020	0.4758	0.5146	0.2758	0.4310	0.7820	0.7355	1.0000	
X_{18}	-0.2795	0.4030	0.3427	0.3522	0.4299	0.6008	1.0000		
X_{19}	-0.1393	0.4646	0.5056	0.3232	0.5157	1.0000			
X_{20}	-0.1275	0.3008	0.3742	0.5328	1.0000				
X_{21}	-0.1635	0.1271	0.0262	1.0000					
X_{22}	-0.1463	0.7848	1.0000						
X_{23}	-0.2231	1.0000							
X_{24}	1.0000								

[1] See text Table 2 for identification of variables.

Appendix Table 32. (continued)

	X_{15}	X_{14}	X_{13}	X_{12}	X_{11}	X_{10}	X_9	X_8	X_7
X_0	0.4605	0.5126	0.5558	0.5950	0.5605	0.4333	0.7766	0.7913	0.7901
X_1	0.4203	0.4488	0.6368	0.6619	0.5733	0.6180	0.6652	0.6586	0.6860
X_2	0.4098	0.4442	0.5817	0.6780	0.5870	0.5523	0.6689	0.7184	0.7119
X_3	0.6391	0.5493	0.6334	0.6437	0.6423	0.5049	0.7732	0.7696	0.8344
X_4	0.4659	0.4356	0.7526	0.5202	0.4754	0.4329	0.6291	0.6080	0.6069
X_5	0.5325	0.6611	0.6577	0.5052	0.5779	0.4663	0.6829	0.6356	0.6165
X_6	0.6980	0.4554	0.5773	0.4009	0.5021	0.2360	0.6706	0.5217	0.5863
X_7	0.4890	0.4891	0.5890	0.6937	0.7209	0.5328	0.8274	0.8630	1.0000
X_8	0.4304	0.4625	0.5381	0.6501	0.7109	0.5193	0.8363	1.0000	
X_9	0.4336	0.3929	0.5190	0.5602	0.6392	0.5085	1.0000		
X_{10}	0.1666	0.2140	0.3148	0.5630	0.5198	1.0000			
X_{11}	0.3874	0.4013	0.4776	0.6497	1.0000				
X_{12}	0.4515	0.4179	0.5047	1.0000					
X_{13}	0.6476	0.7006	1.0000						
X_{14}	0.7010	1.0000							
X_{15}	1.0000								
X_{16}									
X_{17}									
X_{18}									
X_{19}									
X_{20}									
X_{21}									
X_{22}									
X_{23}									
X_{24}									

Appendix Table 32. (continued)

	X_6	X_5	X_4	X_3	X_2	X_1	X_0
X_0	0.5321	0.6477	0.5691	0.7264	0.5993	0.5843	1.0000
X_1	0.4673	0.6481	0.6881	0.6870	0.7012	1.0000	
X_2	0.3858	0.6151	0.6924	0.6835	1.0000		
X_3	0.6850	0.6879	0.6426	1.0000			
X_4	0.5939	0.7623	1.0000				
X_5	0.6825	1.0000					
X_6	1.0000						
X_7							
X_8							
X_9							
X_{10}							
X_{11}							
X_{12}							
X_{13}							
X_{14}							
X_{15}							
X_{16}							
X_{17}							
X_{18}							
X_{19}							
X_{20}							
X_{21}							
X_{22}							
X_{23}							
X_{24}							

Appendix Table 33. NUMBER OF LEAVES COUNTED WITHIN A 10 x 10 CM. FRAME LOCATED OVER THE LEAFIEST PART OF THE PLANT. SEPTEMBER 13-15, 1960.

Reps. Clones	I	II	III	IV	V	VI	VII	Total	$\bar{x}$
1	9.00	14.00	14.00	11.00	8.00	10.00	6.00	72.00	10.28
2	14.00	15.00	13.00	9.00	7.00	10.60	10.74	79.34	11.60
3	16.00	6.00	11.00	9.00	8.00	8.00	16.00	74.00	10.57
4	9.00	11.00	7.00	7.00	7.00	8.00	8.00	57.00	8.14
5	14.00	7.00	12.00	8.00	11.00	5.00	10.00	67.00	9.57
6	9.00	13.00	13.00	11.00	11.00	11.00	11.00	79.00	11.28
7	8.00	10.00	11.00	8.00	11.00	10.00	7.00	65.00	9.28
8	14.00	15.00	10.00	10.00	14.00	15.00	12.31	90.31	7.30
9	10.00	7.00	12.00	13.00	13.00	11.00	9.00	75.00	10.71
10	6.00	13.00	13.00	7.00	14.00	8.00	8.00	69.00	9.86
Total	109.00	111.00	116.00	93.00	104.00	96.60	98.05	727.65	

Appendix Table 34. GENOTYPE MEAN SQUARES FOR THE VARIABLES ASSOCIATED WITH YIELD AS RECORDED IN THREE DIFFERENT DATES[1].

Character Measured	Rating Date: Sept. 2-3, 1960	Sept. 13-15, 1960	Oct. 1-3, 1960	Recovery: Oct. 29, 1960
Length of the petiole	17.9832**	18.0396**	47.9707**	
Length of the middle leaflet	1.3166**	1.3543**	1.2303**	
Width of the middle leaflet	0.2875**	0.4337**	0.5821**	
Spread of the plant	827527.81 **	1590394.8 *	4414882.77	10.06210
Natural height	23.9905	45.4081**	33.4926	29.7657 **
Length of the longest stolon	7.1947**	97.7376**	96.6078**	
Number of internodes in the longest stolon	7.9450*	13.8614**	11.4553*	
Average length of internode in the longest stolon	0.3698**	0.2790**	0.5284**	
Number of stolons per clone	98.7579**	68.8885*		
Visual rating for recovery				16.8317**
Leafiness (10 x 10 frame)		11.9568		

[1] Mean square for dry matter yield: 2861.2916** (October 8, 1960)
Mean square for dry matter percentage: 17.9085* (October 8, 1960)
* Significant at the 5 percent level.
**Significant at the 1 percent level.

Appendix Table 35. FIELD PLAN FOR THE REPLICATED CLONAL NURSERY OF LADINO CLOVER, 1960

Replication						
1	2	3	4	5	6	7
4	5	6	6	1	10	4
2	6	1	10	6	5	9
5	3	5	4	5	6	6
3	8	4	3	4	3	1
8	2	2	5	7	9	10
6	4	3	1	3	7	3
1	7	7	2	9	4	5
7	1	8	7	2	1	7
9	10	10	9	8	8	3[1]
10	9	9	8	10	9[1]	1[1]

[1] Substituting missing plants.