ASSESSMENT OF GENETIC DIVERGENCE BY FACTOR ANALYSIS, IN GROUNDNUT (*Arachis hypogaea* L.)

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "ASSESSMENT OF GENETIC DIVERGENCE BY FACTOR ANALYSIS, IN GROUNDNUT (*Arachis hypogaea* L.)" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship, or other similar title, of any other University or Society.

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C E R T I F I C A T E

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Introduction

INTRODUCTION

Development and implementation of scientific breeding techniques over the past years have given good results. However, potential selection of superior parents is of paramount importance in increasing the genetic worth of a population and thereby increasing the production. The amount of genetic advance by selection depends on the genetic variation prevailing in the population to a large extent. Any additional amount of knowledge of genetic variance, will thus, be of utmost utility in plant breeding programmes. Though, increase in production is the ultimate objective of breeding process, selection based on the high yield alone is not relaible as yield is dependent on many other components. Further, the modern farming techniques like multiple cropping, multi-storeied cropping, inter cropping etc., have broadened the scope of breeding. For these reasons, the concept of breeding for maximum yield have got changed and further objectives like disease resistance, short duration, optimum vegetation etc., have also started agitating the minds of the more curious experimenters. These facts rendered enoughtscope for opening new vistas of statistical techniques in the field of plant breeding. The techniques of multivariate analyses have become all the moree important in plant breeding programmes as the breeder are provided with a set of variables to be handled instead of a single one.

In general, multivariate procedures are concerned with data in which several variables have been assessed for each object under study. These procedures are classified as interdependent analysis, dependent analysis, classification and multidimensional scaling. Factor analysis and principal component analysis are interdependent analytical techniques used to analyse the inter-relations among a set of variables.

Factor analysis has been first developed in the field of psychology to identify the unknown factors of intelligence by analysing the correlation structures of various text scores. It has been recognized, however, as a useful tool in many fields of natural and behavioural sciences in addition to psychology. Not much work has been reported on its use in the field of agriculture. The future need for adaptation and development of factor analysis models and methodology is evident in the growing intersection of social and agricultural sciences. The term factor analysis refers to a number of statistical techniques used for the resolution of a set of observed variables into a few hypothetical variables. In the case of breeding programmes, factor analysis will provide supplementry information on the diversity with a lesser number of causative factors. It is superior to correlation search methods in biological evolution, where the experimenter is unlikely to have a priory knowledge of causative influences. Factor analysis can be used as an exploratory tool for creating hypothesis on the number and nature of causative factors influencing the diversity of a population. Appropriate rotation procedures are developed to find out the exact positions of factors, if two factor solutions on same subjects are available. This type of procedures are termed confirmatory factor analysis.

Principal component analysis can be modified to a factor analytic method, termed factor analysis through principal components. However, the major utility of principal component analysis lies in a parsimoneous summarisation of the data. The model used for principal component analysis is different from factor analysis model as the former lacks error term in it. Discriminant analysis provides the amount of genetic diversity present in the population. The genotypes may then be grouped into clusters and those genotypes belonging to far different clusters can be chosen for hybridization.

Groundnut is an important oil seed crop in India, and accounts for about sixty percent of the total oil seed production. Though, India bags first positon in the area of cultivation,of groundnut, the productivity is much less when compared to other nations. This reveals the enormous potential to escalate the productivity of this crop in India. In Kerala this crop is being cultivated in uplands during kharif season and in rice fallows during summer. In order to understand the genetic structure and scope of genetic improvement in groundnut to Kerala condition, the data generated from plant breeding trials conducted in uplands and rice fallows were utilised with the following objectives.

1. To investigate the possibility of fixing fewer stable factors related to productivity, reproduction and vegetation, to delineate divergent plant populations.

2. To isolate the charaters responsible for differentiation.

3. To estimate genetic divergence for use in plant breeding programmes.

4. To investigate the superiority of factor analysis over principal component analysis and discriminant analysis.

Review of Literature

REVIEW OF LITERATURE

Genetic variability is of considerable importance in any plant breeding programme for crop improvement. Populations from areas far separated geographically and having complex environment are expected to accumulate enormous genetic variability, which offers the plant breeders a unique opportunity for picking up desirable genotypes. An apt choice of character(s) for assessing the variability has thus got importance in this context. Multivariate statistical methods are found to yield valid information on these matters.

Multivariate procedures are concerned within which several variables have been assessed for each object under study. The multivariate analyses may be defined as the branch of statistical analysis which is concerned with the relationships of sets of dependent variables (Kendall, 1968). A series of univariate analysis carried out separately for each variable may sometimes lead to incorrect interpretation of the result, since it ignores the correlations or inter-dependence among the variables. Hence multivariate analysis has emerged as a powerful method to analyse the data represented in terms of many variables.

2.1 Theoretical studies

2.1.1 Analysis of dispersion.

The multivariate analysis of variance or MANOVA began with the derivation of the joint distribution of variance-covariancee of a p-variate normal distribution (Wishart, 1928).

The multivariate T^2 statistic which tests the null-hypothesis that the two centroids coincide in p dimensional variatee space was then introduced by Hotelling in 1931. Wilks (1932) extended the test based on T^2 statistic to k samples, known as Wilk's lambda criterion. Roy and Gnanadesikan (1958) provided a complete generalization of ANOVA to MANOVA.

Bartlet (1947) approximated the distribution of lambda statistic to a chi-square. Rao (1973) showed under null-hypothesis, lambda is a product of independent beta variables.

2.1.2. Estimation of genotypic variance-covariances.

Procedures of partitioning total variance into genotypic and environment components were found in Miller et al. (1958); Jhonson et al. (1955). The randomness of the assignment of genotypes to plots will ensure the independence of genotypes over the environment in the field, which justifies the use of field expements in plant breeding trials (Kempthorne, 1957).

2.1.3 Principal component analysis.

Principal component analysis was first encountered by Karl Pearson (1901) in a problem related with fitting of a line or plane to a scatter of points in higer dimensional space.

Hotelling (1933) described statistical methods of estimation of principal components. He considered principal components as (a) 'the axes which successively account for maximal variability in a sample' and (b) 'testing the variance to be expected on account of the inaccurancy of the tests as revealed by their self-correlations or reliability coefficients'.

Girshick (1936) characterized the principal components as (a) a linear function of variates which has least variance resulting from errors of measurements among the orthogonal linear functions of variates, provided the variables have equal variances of measurements; and (b) a linear function of variates which has the greatest meansquare correlation with the variables.

A chi-square test was developed by Lawley (1956) for testing the significance of the latent roots of covariance and correlation matrices, when the population is multivariate normal.

In a unique paper on principal components Rao (1964) discussed in detail the meaning, interpretations and uses of components in applied research. The descripancy between principal component analysis and factor analysis were also mentioned in this paper.

The transformation of principal components into other linear functions which are meaningful in the biological sense or consistent with results of other similar analyses were described by Holland in 1969. This more general component analysis can lead to condensation of a large data, a better understanding of the observed individuals as entities rather than collections of isolated measurements and the formulation of new hypothesis for subsequent examination.

When the principal component analysis is aimed at the reduction of dimensionality of variables, the number of components to be retained is often subjective and/or arbitrary. Eastment and Krsanowski (1982) described a method for choosing the number of components to be retained by using the correspondence between principal component analysis and the singular value decomposition of the data matrix.

Aitchison (1983) applied principal component analysis for compositional date, consisting of vectors of proportions, through transformation techniques.

Recently, Chang (1983) has disproved the continuing practice of selecting the components with the larger eigenvalues to reduce the dimension before clustering by means of principal components.

2.1.4 Factor analysis.

The inter correlations and the inter dependence among the variables in a multivariate data may be due to certain unobservable inhidden factors. Factor analysis reveals such underlying causative factors of a multivariate data.

The theory of factor analysis begins from Spearman's two factor theory, which assumes that the inter-relationships of all the variables involved could be accounted for by a single underlying general (ability) factor and group factors which are common to some of the variables but not to all of them. In addition to this, a third type factor which are peculiar to single variables alone called specific factors was also differentiated (Spearman, 1904).

Thurstone (1931) generalized Spearman's approach to more than one causal factor. The centroid method of estimation of factor loadings and the simple structure rules of factor rotation are also due to him (Thurstone, 1947).

Holzinger and Harman (1941) presented the principal factor solution of factor loadings.

The statistically important maximum likelihood procedure of factor loading estimation was mainly due to Lawley in a series of papers (1940 and later), those were summarised in Lawley and Maxwell (1963).

The computation schemes of various factor analysis methods were provided by Frutcher (1954).

Rao (1955) introduced the concept of basis of a vector space for the characterization of factor analysis. In the first characterization due to him a factor variable explains as much of variation as possible of the data which leading to principal factor analysis. In second characterization, he considered the factor variable as the one which is predictable from the original measurements with the maximum possible precision, leading to canonical factor analysis. For this solution the squared canonical correlation between the linear function of hypothetical factor variable and the linear function of measurable va variables (of which the hypothetical variables constitute a part) is maximised.

Guttman (1956) demonstrated that the squared multiple correlation with other variables would constitute the lower limit of the communality of a variable.

In the two subsequent papers, Cattell (1965 a and b) attempted an excellent nonmathematical introduction to factor analysis. He preferred to call the analysis with closed model which accounts for all variances of variables in terms of what is in the particular sample as component analysis and with the open model, which admits, besides the common factors, unexplained specific factors as factor analysis. The uses of factor analysis in modern research as hypothesis creating and testing method were also discussed.

An estimation procedure of factor loadings which assumes the variables are sample while the objects represent a statistical population, called 'Alpha factor analysis' is due to Kaiser and Caffrey (1965). Harman and Jones (1966) described the 'Minres solution of factor analysis.

Among the many text books on factor analysis, 'Modern Factor Analysis' due to Harman (1967) is considered as a classical work. Almost all aspects of factor analysis were described in this book.

A theoretical comparison among principal, canonical and alpha factor analysis were made by McDonald (1970). According to him, in choosing a factor method, there are, in fact, at least three separate choices to be made: (1) the choice of basis in the common factor space, (2) choice of an iterative algorithm for the determination of communalities/uniquenesses and (3) the decision rule for the number of common factors.

The maximum likelihood procedure remained impractical for several years because of the slow and uncertain convergence of the process. Joreskog (1967) put forward a new efficient algorithm for this problem, by which a large application of this procedure in applied field of research was made possible.

Joreskog (1970, 1973) presented a theoretical unification of multivariate analysis by a general covariance structure model, by which many other multivariate procedures, including factor analysis can be derived as special cases.

The generalised least square procedure of factor loadings-estimation was provided by Joreskog and Goldberger in 1972.

Williams (1979) has attempted for a comprehensive factor analysis theory, by reviewing three lines of developments which have resulted in (1) a rigorous mathematical foundation for the theory of a factor analysis model (2) the basis for a unified theory of maximum likelihood estimation and testing for this model and (3) significant progress toward the establishment of a unified theory of analytic rotation to aid in the interpretation of factor analysis ~~metho~~ solutions.

Burtholomew (1980) provided a theoretical frame work within which methods for the factor analysis of categorised data can be devised and compared.

Takeuchi et al. (1983) described the theory of factor analysis from a geometric point of view. The drawbacks of factor analysis were discussed in brief by Chatfield and Collins (1980).

Though, the large use of factor analysis is for creating hypothesis, termed exploratory factor analysis, it can also be used for testing hypothesis, termed confirmatory factor analysis (Maxwell, 1977). In such an analysis, two factor loading matrices, obtained from two situations are subjected to rotation to yield a 'unique' position of factors. Cattell and Khanna (1977) described the theory of confirmatory analysis.

Kaiser (1958) published the 'varimax' procedure of analytic rotation, which conceive a wider attention from the practical side of applied research. Many other orthogonal rotation procedures are also in use. The 'Maxplane' procedure due to Cattell and Muerle (1960), helps oblique factor rotation and thus allow correlation between factors.

2.1.5 Discriminant analysis.

The linear discriminant function was proposed by Sir Ronald A Fisher (1936) in a problem related to optimal separation of plants using a number of inter correlated variables.

During the same year, Mahalanobis published the paper on 'generalized distance', which has become the standard measure of distance between two populations, when all the observed characters are quantitative.

Welch (1939) introduced the Neyman-Pearson likelihood ratio principle in discriminanting problem.

Rao (1948) in his classic work, attempted to generalize the D^2 statistic. In addition to this, he generalized Fisher's discriminant function to more than two groups, and discussed the problem of mixed series of samples and the problem of doubtful regions.

A more generalization of discriminant function is due to Bryan (1951). By maximising the ratio of among-groups residual variance to the within-groups variation, he generated a set of orthogonal discriminant functions or canonical variates.

The book by Tatsuoka (1971) provides a comprehensive idea about discriminant analysis.

In a review article Arunachalam (1981) made an exposition of the theoretical concepts behind the genetic distance.

Singh (1981) revealed a mistake committed by the past authors of genetic divergence analysis in assessing the maximum contributing characters towards divergence, and proposed a correct method.

Krzanowski (1983) derived a unique measure of distance between populations on the basis of a mixed data-a mixture of quantitative and categorised data).

2.1.6 Clustering techniques.

Many methods are in practice for clustering objects into groups. They are summarised by Everitt in 1980. A more mathematical discussion is provided by Gordon (1981).

Everitt (1979) discussed in detail the unresolved problems of cluster analysis.

2.1.7 Discarding variables in multivariate analysis.

Beale *et al*. (1967) discussed the problem of discarding variables in (a) regression analysis and (b) interdependent analysis. For the first case they suggested to maximise the multiple correlation between the selected variables and the dependent variable, and for the second case, the rejected variables may be regarded as dependent variables and maximise the multiple correlation coefficient between selected variables and any of the rejected variables.

A simple rule applied in this regard is discard the variable with highest loadings on the redundant latent vector as mentioned by Kendall *et al*. (1983).

2.1.7 Computational algorithms.

The computational outlines of principal factor analysis and canonical factor analysis were given in Seal (1964).

Arunachalam (1967a and b) provided FORTRAN IV programs for canonical variate analysis and for centroid method of factor analysis. Murthy and Arunachalam (1967) published program for computing Mahalanobis D^2, as described in Rao(1952).

Cooley and Lohnes (1971) provided several programs related to multivariate analysis.

Joreskog (1977) presented flow charts with theoretical discussion for factor analysis methods - unweighted least squares generalized least square and maximum likelihood method.

Jennrich (1977) published the theory and computational algorithm for step-wise discriminant analysis.

2.2 Applied studies

Banks (1954) illustrated how the method of factor analysis developed by psychologists to analyse what might be called the mental productivity may be usefully applied to agricultural data in order to deal with such problems as crop productivity.

Murthy and Arunachalam (1967b) applied centroid method of factor analysis to find out the factors underlying in the diversity of the genus sorghum. Three underlying factors were found to be adequate to account for most of the inter-correlations in both the genotypic and environmental correlation matrix.

Wallace and Bader (1967) utilised principal factor analysis with varimax rotation on 27 measurements in the house mouse. Five common factors were identified.

In a centroid method of factor analysis, Murthy et al. (1970) found three factors adequate to account for most of the total communality in sorghum. The results confirmed that the use of human selection would change the factor loadings to a considerable degrees as compared to environmental correlation matrix.

Walton (1972) preported that factor analysis clarified the relationship between correlated characters in the dependence structure in spring wheat. The factor concerned with flage leaf area and duration was found to be the most improtant one.

Singh (1973) utilised the centroid method of factor analysis to study the evolutionary pattern of upland cotton. Three factors were found to be adequate for most of the communality. Both environment and genotypic correlation matrices were subjected to factor analysis.

The analysis of covariance structures was adopted to the simultaneous maximum likelihood estimation of genetical and environmental factor loadings and specific variances by Martin and Eaves in 1977. The goodness of fit is tested by chi-square and standard errors of parameters were obtained for a twin data on cognitive abilities.

Tikka and Asawa (1978) used "factor analysis in lentil through the principal component method as suggested by Harman". Two factors were found important in explaining the relationship of the seven characters considered.

Danis and Adams (1978) performed a principal factor analysis on 22 morphological and yield characters of 16 cultivars and strains of beans.

Data from a cloned plant field trial were used by Willamson and Killick (1978) for canonical analysis of discriminance, principal component analysis and principal coordinate analysis; a measure of Eucledian distance was also computed.

Sundaram et al. (1980) used the centroid method of factor analysis in cowpea to study the evolutionary pattern. Three factors were fitted.

With a six variable study, the principal component analysis showed that most of the variations in late-duration of cultures of rice could be explained by ear-bearing tillers or grain number per panicle and 100 grain weight (Mahajan et al. 1981).

Sawanth et al. (1982) utilised phenotypic correlation among 7 traits in 90 deversified strains of triticale for factor analysis using the principal component method.

Principal component analysis, cluster analysis and canonical analysis were carried out on 22 vegetative and fruit characters to establish the genetic distance between 28 varieties grown in two environments by Cuartero et al. (1983).

A study was conducted with the object to determine the relationship between the characters by extracting minimum number of factors and to determine the importance of yield components in various crops (Sapra, 1984).

Kukadia *et al.* (1984) conducted factor analysis with genotypic correlations to determine the importance of various traits for yield component in forage sorghum.

Bartual *et al.* (1985) used multivariate techniques to classify 125 soyabean lines into clusters. Results obtained from maximum likelihood factor anlaysis and principal component analysis were found somewhat similar. Ward's method of heirarchical clustering was used for grouping the varieties.

Goodman (1968) had used Mahalanobis generalized distance for heirarchical clustering.

A number of investigations concerned with assessment of the genetic diversity in a number of diverse food crops has been published in the past decade and a half. An effort is made here to a selected review of those past works.

Murthy and Arunachalam (1965) used statistical distance and canonical analysis to assess the nature of the genetic diversity in the crops *Brassica*, linseed, wheat, and *Nicotiana*.

Forty five genetic stocks of chilli were subjected to multivariate analysis using D^2 statistic (Singh and Singh, 1976).

Many authors reported that there is no parallelism between genetic and geographic divergence (Peter and Rai in tomato, 1976; Gaur *et al.* in potato, 1978).

Narasinghani *et al*. (1978) reported that seed size, height and days to maturity were the important forces of divergence in peas, by means of D^2 and canonical analysis.

The genetic diversity in caster were assessed by Sing and Srivastava in 1978. Dharker *et al*. (1980) applied genetic divergence analysis in egg plant.

Genetic divergence was measured for the crops triticale, lentil, pigeon pea, linseed, sesame, barley and sunflower respectively by the workers Ahamad *et al*. (1980), Bainiwal and Jatasara (1980), Asthana and Pandey (1980), Yadava *et al*. (1980) Singh *et al*. (1980) and Rao, *et al*. (1980).

Genetic divergence among some brown plant hopper resistant rice varieties was analysed by Rao *et al*. (1980).

Jain *et al*. (1981) used the method, which is similar to the method suggested by Singh (1981) to identify the characters contributing most to the overall divergence in finger millet.

Bhutani *et al*. (1983) studied genetic divergence in 84 genotypes of tomato.

Genetic divergence analysis were carried out in green-seeded peas (Chandal and Joshi, 1983), pearl millet (Shukla and Dua, 1983), Wheat (Jataska and Paroda, 1983), sesamem (Thankavelu and Rajasekharan, 1983), triticale (Kamboj and Mani, 1983), chick pea (Adhikari and Pandy, 1983) and kodo millet (Bhagath and Singh, 1983).

The nature and magnitude of genetic diversity in agronomic and quality characters of 43 scented varieties of rice were studied by Ratho (1984) using Mahalanobis D^2 statistics

Ravindran and Appadurai (1984) subjected 53 inbred pearl millet lines to D^2 analysis and they were grouped into 19 clusters.

Genetic divergence analysis and clustering genotypes by Tochers' method were reported in fodder cowpea (Jindal and Gupta, 1985), pea (Dobhal and Ram, 1985) and water melon (Sidhu and Brar, 1985).

Sangha (1973) had conducted genetic diversity studies in spreading groundnuts. Six characters were considered to assess the genetic distance among 27 varieties.

Reddy and Reddy (1978) reported that in groundnut, number of mature pods had a high coefficient of variability and as well as maximum genetic advance.

Reddy and Reddy (1982) computed discriminant function with different sets of characters and showed that the one comprising yield was more efficient in assessing yield potentialities than indices with out yield in the crop groundnut.

Correlation studies with 18 genotypes of groundnut were carried out by Nagabhushanan et al. (1982). The results revealed that yield was maily associated with 100 kernel weight, number of mature pods, shelling coefficient and number of secondary branches. Principal component analysis were also reported to be carried out for the same data.

Pushkaran (1983) published results of genetic improvement studies in groundnut with a germplasm collection of 93 varieties. Variance-covariance studies and pathcoefficients analysis are made to a data on 23 variables.

Chauhan and Shukla (1985) reported that genotypic variance was higher than environmental variance for all the characters studied except for inter node length in the spreading varieties of groundnut.

Materials and Methods

MATERIALS AND METHODS

3.1 Materials

The data generated from a plant breeding trial in groundnut conducted by the Department of Plant Breeding, College of Agriculture, Vellayani, during kharif 1981 in uplands and summer 1982 in ricefallows at the Research Station and Instructional Farm, Mannuthy were utilised for the present study. The material comprised of 62 bunch type varieties of groundnut, including both exotic and indegenous types. The varieties were grown in randomized block design, replicated thrice (Pushkaran, 1983). Observations on the following characters were considered in the analysis.

1. Pod yield (dry)
2. Length of top on harvest
3. Number of basal primary branches
4. Total number of branches per plant
5. Total number of leaves at harvest
6. Leaf area at harvest
7. Leaf area index at harvest
8. Total number of flowers produced
9. Duration of flowering
10. Number of mature pods per plant
11. Percentage of pod set
12. Number of immature pods per plant

Table 1. List of groundnut varieties taken for the study.

Code Number	Name of the Variety	Code Number	Name of the Variety
1	EC 21127	32	AH 8253
2	EC 21118	33	AK 811
3	EC 116596	34	EC 21078
4	ICG 3859	35	No.70
5	EC 21089	36	USA-_%63
6	EC 21216	37	G-270
7	EC 24412	38	Russia 319
8	EC 115678	39	TMV 12
9	EC 25188	40	Almel No.1
10	EC 24395	41	TMV 2
11	EC 21082	42	KG-61-240
12	IC 9811	43	USA-123
13	EC 24431	44	TMV 11
14	EC 21095	45	Pollachi - 2
15	A-674	46	AH 4218
16	B-353	47	TG 3
17	EC 1132	48	TG 19
18	IC 9808	49	EC 21088
19	EC 21079	50	Kanki-X-10-17
20	EC 35999	51	Spanish peanut
21	EC 21052	52	Red spanish
22	AH 6915	53	Pollachi-1
23	EC 24450	54	Exotic-1
24	GAUG-1	55	TMV 7
25	J-11	56	Gangapuri
26	Spanish improved	57	EC 20957
27	S-206	58	No.293
28	DH-3-50	59	AH 4128
29	Jyothi	60	Co.1
30	TMV 9	61	Uganda local
31	No.297	62	EC 21070

3.2 Methods

Measurements on p biometrical characters x_1 ... x_p for 'n' varieties (genotypes) were denoted by

$$X_{ijk}$$

i=1 ... p; j=1 ... n; k=1 ... r, where r is the number of replication. The data were subjected to following statistical analysis.

3.2.1 Preliminary statistical analysis.

The model to be fitted for the multivariate analysis of variance of randomized block design is

$$X_{ijk} = \mu_i + g_{ij} + b_{ik} + e_{ijk} , \quad i=1 \ldots p,$$

where μ_i is the general mean, g_{ij} is the genotypic effect of the jth genotype, b_{ik} is the kth block effect and e_{ijk} is the error component, with respect to the ith character and e_{ijk} are normally distributed with mean zer and constant variance $\sigma_{e_i}^2$

The least square estimates of the constants of the model are

$$\mu_i = \bar{X}_{i..}$$
$$g_{ij} = \bar{X}_{ij.} - \bar{X}_{i..}$$
$$b_{ik} = \bar{X}_{i.k} - \bar{X}_{i..}$$

The analysis of dispersion is summarised and presented in Table 2.

The F-values for testing the equality of varietal means of 'p' characters are the ratios of the diagonal elements of the "between" (B) and "within" (W) dispersion matrices.

Table 2. Multivariate analysis of variance (RBD).

Source of variation	d.f.	Mean sum of product matrix
Blocks	r-1	R
Genotypes	n-1	B
Error	(n-1)(r-1)	W
Total	nr-1	

Wilk's lambda criterion (Wilks, 1932) is proved to be the best statistical method for the simultaneous test of homogeniety of varietal means for all the charaters considered together.

For RBD MANOVA, the lambda statistic, which is the ratio of determinants of 'residual' and 'residual + deviation from hypothesis' is

$$\Lambda = \frac{|W|}{|W+B|}$$

Bartlet (1947) had showed that under null hypothesis, the statistic

$$-m \log_e \Lambda$$

is approximately distributed as a chi-square with p(n-1) degrees of freedom, where $m = nr-1+(p+n)/2$.

3.2.2 Estimation of genetic covariance matrix.

Following the terminology due to Kempthorne (1957), the expected values of the within and between mean sum of product matrices shall be written as

$$E(W) = \Sigma_e = (\sigma_{eij})$$
$$E(B) = \Sigma_e + r\Sigma_g = (\sigma_{eij} + r\,\sigma_{gij})$$

where is the genotypic covariance between the traits i and j. Then an estimate of the genotypic covariance matrix is

$$G = (B - W)/r.$$

3.2.3 Variables descarding criterion.

In order to reduce the number of variables, a simple method of dropping the variable with the highest loading on the redundant latent vector was used (Kendall *et al.*, 1983). As Beale *et al.* (1965) had pointed out, the question on the number of variables to be included is decided on the grounds that are partly statistical, and subjective decisions may be taken .

3.2.4. Principal component analysis.

The principal component analysis, initially described by Karl Pearson (1901) and further developed by Hotelling (1933), consists of finding an orthogonal transformation of the original variables to a new set of uncorrelated variables, called principal components, which are derived in decreasing order, in the sense that, the first principal component accounts maximum possible variance, the second accounts next to the first and so on.

let $X' = (x_1 \ldots x_p)$ be a p-dimensional random vector with mean vector μ and covariance matrix Σ.

For deriving the first principal component, $Y_1 = P_1'X$, which accounts maximum variance, a constraint $P_1'P_1 = 1$ is required.

Maximising $Var(Y_1)$, subject to the condition mentioned above, will result in the matrix equation

$$(\underset{\sim}{\Sigma} - \lambda \underset{\sim}{I}) \underline{P}_1 = \underset{\sim}{0}$$

where λ is the Lagranger's multiplier.

A solution other than a null vector for P_1 is possible only when the matrix

$$(\underset{\sim}{\Sigma} - \lambda \underset{\sim}{I})$$

is singular.

i.e.

$$|\underset{\sim}{\Sigma} - \lambda \underset{\sim}{I}| = 0$$

which implies that λ is an eigen root of $\underset{\sim}{\Sigma}$ and $\underline{P}_1$, the corresponding eigen vector.

If so, $Var(Y_1) = \lambda$, and as it should be maximum, one should take λ as the largest root.

In a similar way of arguments, and with two additional constrainsts $P_2'P_2 = 1$ and $P_1'P_2 = 0$, it can be proved that the second principal component Y_2 is $P_2'X$, where P_2 is the deigen vector corresponding to the second largest eigen root of Σ.

Thus in algebraic terms, pricipal components analysis is the extraction of eigen roots and vectors of the covariancee matrix Σ. If the variables are in different scales of measures a correlation matrix, instead of Σ will be appropriate.

If the last p-q latent roots of Σ are found to be negligible (more correctly, if they are found to be indistinguishable), without much los of information, the p-dimensional variables can be replaced by the first q principal components. In such cases the first q principal components are said to explain

$$100 (\pi_1 + \cdots + \pi_q) | (\pi_1 + \cdots + \pi_p)$$

percent of total variance (Rao, 1964).

If X is multivariate normal, statistical tests are available to test whether the p-q latent roots are distinguishable (Lawley, 1956). But when a correlation matrix obtained from a sample covariance matrix is used, the testing criteria may get complicated (Kendall et al., 1983).

Many methods are available to evaluate the latent roots and latent vectors of a matrix. The Jacobi's method applicable for symmetric matrices, involves the diagonalisation of the matrix by performing a sequence of orthogonal transformations on it, designed to reduce one off-diagonal element to zero at each stage (Harman, 1967). Based on such a FORTRAN IV subroutine a program in BASIC is developed for evaluating the eigen roots and vectors of s symmetric matrix.

Principal component analysis were carried out for environment and genotypic correlation matrices.

The column vectors obtained by multiplying the latent vectors with their corresponding latent roots, will give some information regarding the important characters of that component. These new vectors are called 'principal component loadings' and the procedures is termed as factor analysis through the principal component method.

3.2.5 Factor analysis.

Factor analysis is a common term for a number of statistical techniques for the resolution of a set of observed variables $X_1 \ldots X_p$, in terms of a fewer number of 'underlying causative' factors $f_1 \ldots f_k$, (k p) that will account for the inter correlations of the observed variables, in the sense that when the factors are partialled out from the observed variables, there no longer remain any correlation between those variables.

The basic model in factor analysis is

$$X = \mu + \Lambda f + e \quad (1)$$

where X is a column vector of observations on p variables, μ is the mean vector of X, f is the vector of k common factors, e is the vector of p residuals and $\Lambda = (\Lambda_{ij})$ is a pxK matrix of factor loadings (Joreskog, 1977). Further

$$\mathrm{Cov}(e,f) = 0$$

$$E(f) = 0$$

$$E(ff') = \phi$$

$E(ee') = \psi^2$, which is diagonal with elements ψ^2_{ii}, i=1 ... p.

Then the variance-covariance matrix Σ of X becomes

$$\Sigma = A \phi A' + \psi^2 \qquad (2)$$

If $(p-k)^2 < p+k$, this relationship can be tested statistically unlike (1), which involves hypothetical variates and cannot be verified directly (Joreskog, 1972).

The above covariance structure may directly be obtained from the general covariance structure model for the multivariate normal population (Joreskog, 1972, 1973).

$$\Sigma = B (A \phi A' + \psi^2) B' + \Theta^2$$

by specifying B=I and Θ =0.

Equations (1) and (2) represent a model for a population of individuals characterised by the parameters μ , A , ϕ and ψ^2. In practice these parameters are unknown and will be estimated from a data on N individuals (Joreskog, 1977).

In general, the sample mean vector $\bar{X}$, is taken as an estimate of μ. The remaining estimation problem is then to fit Σ of the form (2) to an observed correlation matrix S.

Several methods such as maximum likelihood method (Lawley and Maxwell, 1963; Joreskog, 1967), Canonical factor analysis (Rao, 1955), generalised least square method (Joreskog and Goldberger, 1972), Principal factor analysis (Holzinger and Harman, 1941), Centroid method (Thurstone, 1947), miners solution of factor loadings (Harman and Jones, 1966) etc., are in use for fitting Σ to S. Among these methods the principal factor solution ~~is~~ seems to be widely utilised.

When variables are measured in different units, it is advised to standardise the observations, then Σ becomes a correlation matrix rather than a covariance matrix.

If $k > 1$, there is an indeterminancy in (2) arising from the fact that a non-singular transformation of 'f' changes Λ and in general also ϕ but leaves Σ unchanged (Joreskog, 1977). In principal axes solution, this indeterminancy is eliminated by choosing $\phi = I$ and $\Lambda'\Lambda$ to be a diagonal. Then (2) will takes the form

$$\Sigma = \Lambda \Lambda' + \psi^2$$

The diagonal elements of $\Lambda'\Lambda'$ are called communality, by which is meant the amount of variance of the characters accounted for by the 'k' common factors. They are denoted by the diagonal matrix D_h^2. The matrix

$$\Sigma_f = \Sigma - \psi^2 = \Sigma - I_p + D_h^2$$

is called the residual matrix.

Starting from an initial or guess values of communality, in principal factor solution, they are asuccessively re-estimated until the solution converges.

If $D_{h(1)}^2$ is an initial estimate of communalities, a first approximation to the factor loadings is given by

$$\Sigma_{f(1)} = \Lambda \Lambda'$$

where

$$\Sigma_{f(1)} = \Sigma - I_p + D^2_{h(1)}$$

then

$$\Lambda = E_k \Delta_k^{1/2}$$

where E_k is a p X k matrix whose columns are constituted by the first ~~eig~~ 'k' eigen ~~roots~~ vectors of $\Sigma_{f(1)}$, and $\Delta_k^{1/2}$ is a k X k diagonal matrix, with square root of first 'k' eigen roots of $\Sigma_{f(1)}$ in the principal diagonal. Now the diagonal elements of

$$(E_k \Delta_k^{1/2})(\Delta_k^{1/2} E_k')$$

can be considered as an improved approximations of communality. With these new values in the principal diagonal of Σ, a second approximation to factor loadings can be found out. This process will continue until the two successive values of the communality agree to a choosen number of significant figures.

The convergence of the sum of squared elements of

$$\Sigma_{f(j)} - A_{(j)} A'_{(j)},$$

which is same as the quantity

$$Q = \text{trau}\{\Sigma_{f(j)} - A_{(j)} A'_{(j)}\}^2$$

may also be considered for the termination of the process.

The computer program in BASIC, based on the instruction given by Seal (1964) and Takeuchi et al. (1983) is given in appendix.

As the lower bound of communality is the squared multiple correlation (Guttman, 1956), it can be considered as a first approximation of communality and hence the communalities are the diagonal elements of

$$I_p - \{\text{diag}\ \Sigma^{-1}\}^{-1}$$

The maximum correlations in each row or column may be taken as initial values of communality (Cattell, 1965).

As the number of factors concerned, only "certain rules of thumb" is till available for practical purposes, such as taking as many factors with corresponding eigenvalues greater than unity or number of factors necessary for yielding the contribution ratio more than 0.95 etc.. But it seems to be convenient to take only a few number of factors, that are easily be interpretable.

3.2.6 Factor rotation.

The elimination of indeterminancy of the model (2) leads to an arbitrary set of factor loadings, which may then be subjected to rotation or a linear transformation to another set of factors to facilitate a more meaningful interpretation (Joreskog, 1977).

Let (Λ_{ij}), (i=1 ... p: j=1 ... k) be the final approximations of factor loadings. The 'simplicity' of a factor is defined as

$$V_j = \{ p \sum_i (\Lambda_{ij}^2)^2 - (\sum_i \Lambda_{ij}^2)^2 \} / p^2$$

the variance of the squared factor loadings (Kaiser, 1958).

The 'varimax' criterion of factor rotation involves the maximisation of the simplicity of a factor matrix

$$\sum_j V_j \Big/_{MAX.}$$

The modified varimax criterion is maximising

$$V = \sum_j \left\{ \left[p \sum_i (A_{ij}^2 / h_i^2)^2 - \left(\sum_i (A_{ij}^2 / h_i^2) \right)^2 \right] \Big/ p^2 \right\}$$

where h_i^2 is the communality of the ith variable.

In this, so called 'normalized varimax criterion', the variance of the squared correlations of the common parts of the variables with a factor is maximising, instead of maximising the squared correlations of the variables with a factor as in Thurstone's (Thurstone, 1947), simple structure criterion' (Kaiser, 1958).

A BASIC version of the FORTRAN IV program provided by Cooley and Lohnes (1971) is used for "normalised varimax rotation".

3.2.7 Discriminant analysis.

Let there be two multivariate populations with probability densities

$$f_i = c \cdot \exp \cdot \left\{ -\tfrac{1}{2} (x - \mu_i)' \Sigma^{-1} (x - \mu_i) \right\}, \; i = 1, 2$$

where μ_i is the mean vector of the population i and Σ is the common dispersion matrix.

Suppose that an individual is drawn at random from a population in which the two groups are mixed up in some ratio $\pi_1 : \pi_2$ which is unknown. Now it requires a partitions of the p-dimensional space in to two mutually exclusive regions, R_1 and R_2 with the rule of procedure of assigning an individual to ith group if it falls in R_i.

The probability of misclassification α is then

$$\alpha = \int_{R_1} f_2 \, dv = \int_{R_2} f_1 \, dv \qquad (3)$$

is accordence with the logical requirement that the frequency of misclassification is same for individuals of both the groups. This probability should be the minimum possible.

From (3)

$$1 - \alpha = \int_{R_1} f_1 \, dv = \int_{R_2} f_2 \, dv$$

Welch (1937) has shown that the best possible regions are defined by

R_2 defined by $f_2 \geqslant bf_1$

R_1 defined by $f_2 \leqslant bf_1$

where b is choosen such that

$$\int_{R_2} f_1 \, dv = \int_{R_1} f_2 \, dv.$$

In the present context, R_2 is defined by

$$L'X \geqslant a$$

where

$$L = \Sigma^{-1} d$$

and

$$d = \mu_1 - \mu_2$$

The quantity α is then the common value of

$$\int_{L'x \geq a} f_1 \, dv = \int_{L'x \leq a} f_2 \, dv$$

This can be determined by considering only the distribution of $L'X$, which is univariate normal (Rao, 1948).

By considering the first integral, it may be shown that

$$\alpha = \int_{D/2}^{\infty} e^{-\frac{1}{2} Y^2} \, dY \qquad (4)$$

where

$$Y = \frac{L'X - L'\mu}{D}$$

and

$$D = d' \Sigma^{-1} d$$

A decreasing function of this 'probability of misclassification' α , which increases with the increase in separation of two groups may consdiered as a measure of separation or distance between the two groups. One such function is $1 - \alpha$ (Rao, 1948).

From the relation (4)

$$1 - \alpha = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{D/2} e^{-\frac{1}{2} Y^2} \, dY$$

which shows that $1-\alpha$ is an increasing function of D. The measure $1-\alpha$ may thus, be conveniently replaced by Mahalanobis' generalised distance.(Mahalanobis, 1936; Rao, 1948).

The observed phenotypic values of the characters are often the environment modified genotypic values. When the genotypes are grown in an appropriate field design, the mean error dispersion matrix 'W' will provide the common dispersion matrix Σ used in the divergence analysis (Arunachalam, 1981). Further as the genotypes are grown under uniform environment, the phenotypic values my taken for genetic comparisons. Thus the genetic divergence analysis is made possible.

As the computation of $d'\Sigma^{-1}d$ is time consuming, when all possible pairs of populations taken, the original X variables are transformed to univariate uncorrelated Y variables by the method described by Rao (1952). Then

$$d'\Sigma^{-1}d = (d_y')(d_y) = \sum_{i=1}^{p}(\bar{Y}_{i1}-\bar{Y}_{i2})^2$$

Thus the distance matrix showing the genetic distances between the varieties prepared.

To find out the relative importance of characters affecting genetic divergence, the method suggested by Singh (1981) is used. Bryan (1951) had proved that the coefficients of the discriminant function are determined by the determinent equation

$$|W^{-1}B - \lambda I)l = 0$$

which implies that 'l' is the latent vector of $W^{-1}B$.

The within dispersion of the transformed character is an identity matrix and as such the above determinant equation will take the form

$$|B^* - \lambda I| = 0$$

where B^* is the between dispersion matrix of Y-variables.

The generated variables c'Y is called canonical variates (Rao, 1948). Naturally, the largest elements of the latent vectors obtained will contribute most to dispersion. Since the elements of 'c' are correspond to the transformed variables, a judgement about the maximum contributing character based on the elements of 'c' will be misleading.

The new method suggested by Singh (1981) helps to findout the elements of 'l' from the elements of 'c' as

$$l' = c'(V')^{-1}$$

where V is the triangular matrix used for the transformation of X-variables to Y-variables.

In view of the fact that the elements of 'l' are affected by the particular values of λ_i, they are standardised by multiplying each element of 'l' with the standard deviation of the corresponding character, as suggested by Tatsuoka (1971).

3.2.8 Clustering of genotypes.

A number of clustering methods are used in the construction of classificatory systems. This involves two process; first, the derivation of dissimilarity coefficient and second, the transformation of the dissimilarity coefficient into a classificatory system. Mahalanobis'generalised distance provides a measure of genetic dissimilarity among genotypes.

For the second stage of the classification process, heirarchical or non-heirarchical methods ~~are~~ many are in use.

The average link method which operates on an agglomerative algorithm is a simple procedure of heirarchical clustering. At each stage of this method, a pair of existing groups is amalgamated: the pair chosen for amalgamation leads to the minimum increase in the average distance. And if two groups G_i and G_j amalgamate to form a new group, the dissimilarity between this group and any other group (individual G_k is

$$d_{k(i,j)} = (\tfrac{1}{2})d_{ki} + (\tfrac{1}{2})d_{kj}$$

(Gordon, 1981). The results may be presented in the form of a dendrogram, which is a two-dimensional diagram illustrating the fushions or partitions which have been made at each successive level (Everitt, 1980).

Sectioning a dendrogram at any level yields a partition of the data set, but the resulting groups may not possess internal homogeneity. But there is an optimum height, that will produce groups which have comparable degrees of homogeneity. Empirical methods are often used to identify this optimum level. One suggestion is to choose the height corresponding to some observed clumping of the splitting-levels in the dendrogram. An alternate method is tried for fixing the height of the dendrogram, in which the height is chosen as the level of the average coefficient of variation of characters.

Results

RESULTS

The data generated from a plant breeding experiment in groundnut conducted in uplands (data A) and rice fallows (data B) were subjected statistical analyses and the results are presented below.

4.1. Results of data A

4.1.1 Preliminary statistical analysis.

The analysis of dispersion was done and the total dispersion was split up into 'replication', 'between', and 'within' dispersion with the degrees of freedom 2, 61 and 122 respectively.

The between dispersion and within dispersion matrices are provided in appendices 1 and 2, in the form of correlation matrices, along with standard deviation of variables.

The F-values for testing the equality of character-wise varietal means were given in Table 3. All the characters, except plant spread on 50th day were found to distinguish the genotypes.

The values obtained for Wilk's lambda statistic was

$$\Lambda = 1.74658 \times 10^{-25}$$

so that,

$$- m \log_e \Lambda = 3297.78$$

a chi-square with d.f. 1830, was significant at one percent level.

Table 3. The F-values obtained from the character-wise RBD - Anova of data A.

	Variables	F-values
1	Dry pod yield	6.226
2	Length of top at harvest	5.754
3	Number of basal primary branches	3.023
4	Total number of branches per plant	6.684
5	Total number of leaves at harvest	2.073
6	Leaf area at harvest	9.125
7	Leaf area index at harvest	8.856
8	Total number of flowers produced	8.059
9	Duration of flowering	56.900
10	Number of mature pods per plant	5.489
11	Percentage of pod set	21.298
12	Number of immature pods per plant	2.715
13	Ratio of mature to immature pods	2.557
14	Hundred pod weight (dry)	808.863
15	Hundred kernel weight	8.352
16	Shelling percentage	238.747
17	Haulm yield	6.489
18	Days to fifty percentage flowering	3.197
19	Duration of maturity	27.592
20	Plant height on 50th day	3.742
21	Plant spread on 50th day	0.899+
22	Number of branches on 50th day	5.708
23	Number of leaves on 50th day	2.665
24	Leaf area on 50th day	3.961
25	Leaf area index on 50th day	4.196
26	Height of main shoot at harvest	5.080
27	Driage percentage of pods	34.914
28	Oil percentage	2.797
29	Pod yield per plant	4.920
30	Kernel yield per plant	6.963

+ Non significant: All others are significant at 1% level.

The character-wise varietal means are presented in the appendix 3.

4.1.2 Estimated genetic covariances.

T The estimated genetic variance of the character 'plant spread on 50th day'(21) was found negative (-1.753). The genetic correlation matrix, excluding this character, along with standard deviations of characters is given in appendix 4.

Some of the estimated genetic correlation coefficients were B found exceed unity. The genetic correlation between the characters total number of branches at 50th day (22) and total number of leaves at 50th day (23): and these characters with 'number of basal primary branches (3), and total number of branches per plant (4) showed values greater than unity, between number of basal primary branches and total number of branches per plant and leaf area at harvest and leaf area index at harvest (7) were near to unity, and between leaf area at 50th day (24) and leaf area index at 50th day (25) was equal to unity. Further, the characters (6) and (7) were found to have high genetic correlation with (24) and (25)

4.1.3 Reduced dimensions and discarded variables.

The character plant spread at 50th day (21) was discarded first as it was ~~not~~ found not to distinguish the genotypes and further it has a negative value for the genetic variance estimator.

The eigen roots and eigen vectors of the within correlation matrix of the remaining 29 variables were worked out. The latent roots of the matrix were given in Table 4c. The last five latent roots were found to have little contribution towards total variability (0.55 per cent). The latent vectors corresponding to these last 5 latent roots were shown in Table 4b.

The variables having large coefficients in the rdundant vectors were (1) and (29) in the 29th vector,(29) and (30) in the 28th vector, (6) and (7) in the 27th vector, (24) and (25) in 26th vector and (2) and (26) in 25th vector. These variable pairs showed high values in the within correlation matrix.

The variables (1), (2), (7) and (25) were decided to be discarded. The variables (29) or (30) may also be discarded, but were not discarded as they were important economic traits.

Further the variables percentage pod set (11) and ratio of mature to immature pods (13) were also discarded. Thus by discarding the variables,

1. Yield of pods (1)
2. Length of top (2)
3. Leaf area index at harvest (7)
4. Percentage of pod set (11)
5. Ratio of mature to immature pods (13)
6. Plant spread at 50th day (21)
7. Leaf area index at 50th day (25).

Table 4a. Latent roots, withdrawing the variable 21, of the within correlation matrix of data A.

Sl No	Latent Roots	Percent contribution to variance
1	6.9091	23.82
2	4.0682	14.03
3	2.1509	7.42
4	1.9561	6.75
5	1.8395	6.34
6	1.5587	5.37
7	1.4220	4.90
8	1.2148	4.19
9	1.0843	3.74
10	0.9160	3.16
11	0.8596	2.96
12	0.8044	2.77
13	0.7656	2.64
14	0.6980	2.41
15	0.5039	1.74
16	0.3979	1.37
17	0.3599	1.24
18	0.2921	1.01
19	0.2698	0.93
20	0.2268	0.78
21	0.1609	0.55
22	0.1416	0.49
23	0.1156	0.40
24	0.0980	0.34
25	0.0740	0.26
26	0.0597	0.21
27	0.0274	0.09
28	0.0198	0.07
29	0.0053	0.02

Table 4b. The latent vectors corresponding to the last five latent roots of Table 4a.

Variable Codes	Latent vectors 25	26	27	28	29
1	-.043	0.015	-.001	0.216	-.774
2	0.659	-.108	0.013	-.006	-.037
3	-.050	0.070	-.104	-.011	0.015
4	0.144	0.007	0.071	0.025	-.007
5	0.108	0.000	0.081	0.009	0.018
6	-.066	-.162	-.701	-.064	-.017
7	-.095	0.094	0.652	0.041	-.008
8	-.110	-.061	0.014	-.032	-.013
9	0.103	0.052	0.013	0.035	-.002
10	0.062	0.041	-.066	0.008	-.006
11	-.021	0.051	-.014	-.020	-.024
12	0.025	-.132	-.035	-.059	0.014
13	0.001	-.091	0.012	-.053	0.006
14	0.044	0.028	-.041	0.016	0.000
15	0.014	-.029	0.034	-.025	-.025
16	-.007	0.062	-.048	0.053	-.020
17	-.001	-.029	0.007	-.003	-.011
18	-.024	0.063	-.003	-.025	0.007
19	0.010	-.000	0.007	0.035	-.006
20	-.031	0.033	0.005	0.018	0.014
22	0.018	-.049	0.031	0.011	-.005
23	0.006	-.118	-.035	-.026	-.009
24	-.137	-.594	0.144	0.056	0.004
25	0.106	0.717	-.102	-.025	-.003
26	-.672	0.135	-.031	0.010	0.035
27	0.037	-.015	-.011	0.051	0.050
28	0.007	-.000	-.002	-.004	0.001
29	0.021	0.013	-.040	0.565	0.588
30	-.006	-.006	0.078	-.272	0.217

the variable dimension was reduced to 23.

Principal component and factor analysis were performed with this reduced variable dimension.

Eight more variables were discarded at the second stage. (For reasons, see Chapter 5, Discussion, page 105). They were (3), (5), (15), (16), (22), (23), (24) and (29). All the multivariate analyses described in 3.2 were carried out with the remaining 15 variables numbered 4, 6, 8, 9, 10, 12, 14, 17, 18, 19, 20, 26, 27 and 30.

4.1.4 Principal component analysis.

Principal component analysis was performed with environment correlation matrix of order 23. The results are presented in tables: Table 5a-5c.

The first three eigen roots accounted only for 45.39 per cent towards to total variance and the first four roots 52.44 per cent.

The latent vectors corresponding to the first 4 latent roots are given in Table 5b. The principal component loadings of these vectors and the varimax rotated loadings are shown in Table 5c.

Rotation of the loadings were found helpful to ascertain the contributing characters. The characters which are dominant in the vectors of Table 5c, in order of magnitude

Table 5a. Latent roots, omiting 7 variables, of the within correlation matrix of data A.

Sl No	Latent roots	Percent contribution to variance
1	5.430	23.61
2	3.158	13.73
3	1.852	8.05
4	1.624	7.06
5	1.343	5.84
6	1.202	5.23
7	1.135	4.94
8	0.992	4.31
9	0.872	3.79
10	0.791	3.44
11	0.756	3.29
12	0.712	3.09
13	0.658	2.86
14	0.567	2.46
15	0.434	1.89
16	0.329	1.43
17	0.278	1.21
18	0.251	1.09
19	0.229	1.00
20	0.145	0.63
21	0.114	0.50
22	0.108	0.47
23	0.020	0.09

Table 5b. The latent vectors corresponding to the first four latent roots of Table 5a.

Variable Code	Latent vectors			
	1	2	3	4
3	0.225	-.235	-.153	0.282
4	0.223	-.264	-.175	0.185
5	0.223	-.283	0.150	0.117
6	0.203	-.319	0.140	0.095
8	0.297	0.272	-.042	-.163
9	0.271	0.233	-.059	-.163
10	0.322	0.245	0.020	0.011
12	0.211	0.185	-.096	0.117
14	0.040	-.078	0.142	-.117
15	0.056	0.061	0.118	0.482
16	0.059	0.007	0.406	-.043
17	0.180	0.038	-.120	0.391
18	0.028	-.025	-.518	-.079
19	0.016	-.147	-.546	0.042
20	0.139	0.069	0.164	-.040
22	0.265	-.316	0.047	-.045
23	0.236	-.313	0.088	-.209
24	0.241	-.271	0.091	-.268
26	0.110	0.109	0.071	0.179
27	-.035	-.161	-.134	-.449
28	-.103	-.059	0.197	0.107
29	0.339	0.255	-.008	-.058
30	0.336	0.228	-.019	-.142

Table 5c. Component loadings and rotated loadings of the four latent vectors of Table 5b.

Variable code	Component loadings 1	2	3	4	Rotated loadings 1	2	3	4	A
3	0.525	-.419	-.209	0.359	0.089	-.645	-.292	0.338	0.623
4	0.519	-.469	-.239	0.235	0.088	-.672	-.315	0.206	0.601
5	0.520	-.503	0.204	0.150	0.051	-.739	0.128	0.152	0.588
6	0.475	-.568	0.192	0.121	-.013	-.759	0.112	0.102	0.600
8	0.692	0.484	-.057	-.208	0.871	-.035	0.015	0.005	0.760
9	0.631	0.416	-.080	-.208	0.786	-.049	-.015	-.019	0.621
10	0.751	0.436	0.028	0.015	0.827	-.126	0.071	0.228	0.757
12	0.492	0.328	-.131	0.149	0.544	-.041	-.110	0.279	0.389
14	0.094	-.139	0.194	-.149	0.011	-.179	0.191	-.140	0.088
15	0.131	0.109	0.161	0.615	-.000	-.035	0.108	0.648	0.433
16	0.139	0.013	0.553	-.055	0.080	-.126	0.553	0.016	0.328
17	0.420	0.067	-.164	0.498	0.254	-.211	-.207	0.551	0.455
18	0.065	-.045	-.705	-.102	0.110	-.004	-.693	-.150	0.514
19	0.038	-.261	-.743	0.054	-.072	-.158	-.770	-.049	0.625
20	0.326	0.123	0.223	-.051	0.315	-.124	0.238	0.047	0.174
22	0.618	-.563	0.065	-.057	0.155	-.824	0.004	-.054	0.706
23	0.550	-.557	0.119	-.267	0.247	-.775	0.080	-.262	0.699
24	0.563	-.483	0.125	-.342	0.223	-.722	0.101	-.317	0.682
26	0.257	0.193	0.096	0.228	0.246	-.026	0.093	0.308	0.165
27	-.083	-.286	-.182	-.572	-.075	-.132	-.154	-.635	0.450
28	-.240	-.106	0.268	0.136	-.303	0.034	0.240	0.090	0.159
29	0.791	0.453	-.011	-.074	0.892	-.130	0.043	0.148	0.836
30	0.784	0.405	-.026	-.181	0.886	-.157	0.034	0.035	0.812
Sum of squared factor loadings:					4.400	4.008	1.866	1.792	
Variance accounted by factors:					0.191	0.174	0.081	0.078	

A - Communality obtained.

are
were given below:

Vector I :- Pod yield per plant (29)

Kernel yield per plant (30)

Number of flowers produced (8)

Number of mature pods per plant (10)

Duration of flowering (9)

Vector II :- Number of branches per plant on 50th day (22)

Number of leaves on 50th day (23)

Leaf area at harvest (6)

Number of leaves at harvest (5)

Number of branches per plant (4)

Leaf area on 50th day (24)

Number of basal primary branches per plant (3)

Vector III :- Duration to maturity (19)

Number of days to 50 percentage flowering (18)

Vector IV :- Hundred kernel yield (15)

Driage percentage of pods (27)

Haulm yield (17).

The character immature pods per plant (12) was also showed considerable loading on first axis.

The eigen roots of genetic correlation matrix of order 23 are given in Table 6. Some of the eigen roots were negative. Hence principal component analysis was not performed for this matrix.

The results of principal component analysis for the environment correlation matrix of order 15 are summarised

Table 6. Latent root, omitting 7 variables, of the genetic correlation matrix of data A.

Sl. no.	Latent roots
1	6.639
2	4.352
3	2.691
4	2.181
5	1.564
6	1.337
7	1.162
8	0.888
9	0.616
10	0.532
11	0.500
12	0.362
13	0.321
14	0.164
15	0.148
16	0.092
17	0.002
18	-.005
19	-.025
20	-.044
21	-.081
22	-.139
23	-.258

Table 7a. Latent roots of the environment correlation matrix of order 15 of data A.

Sl. No.	Latent Roots	Contribution to Variance
1	3.817	25.44
2	1.757	11.71
3	1.426	9.51
4	1.287	8.58
5	1.071	7.14
6	1.024	6.83
7	0.922	6.15
8	0.808	5.39
9	0.710	4.74
10	0.596	3.98
11	0.544	3.63
12	0.401	2.67
13	0.297	1.98
14	0.204	1.36
15	0.135	0.90

Table 7b. The latent vectors corresponding to the first four latent roots of Table 7a.

Variable Code	Latent vectors 1	2	3	4
4	0.157	-.392	0.480	0.055
6	0.111	-.249	0.565	0.011
8	0.434	0.072	-.172	-.113
9	0.400	0.035	-.123	-.066
10	0.438	0.076	-.065	-.081
12	0-314	-.023	-.057	0.139
14	0.002	-.030	0.226	-.446
17	0.218	-.099	0.235	0.263
18	0.033	-.509	-.419	0.113
19	-.015	-.614	-.217	0.209
20	0.183	0.197	0.126	0.177
26	0.182	0.116	0.136	0.453
27	-.100	-.195	0.118	-.450
28	-.138	0.188	0.086	0.350
30	0.424	-.008	-.040	-.262

Table 7c. Component loadings and rotated loadings of the four latent vectors of Table 7b.

Vari-able code	Component loadings				Rotated loadings				A
	1	2	3	4	1	2	3	4	
4	0.307	-.519	0.573	0.063	0.105	-.152	0.809	-.085	0.696
6	0.216	-.330	0.675	0.012	0.019	0.066	0.772	-.102	0.612
8	0.848	0.095	-.206	-.128	0.883	0.018	0.002	0.080	0.787
9	0.782	0.046	-.194	-.075	0.803	-.030	0.025	0.102	0.657
10	0.855	0.101	-.077	-.092	0.852	0.079	0.114	0.105	0.756
12	0.614	-.030	-.068	0.158	0.557	-.084	0.156	0.256	0.408
14	0.005	-.040	0.270	-.506	0.051	0.214	0.160	-.506	0.331
17	0.426	-.132	0.281	0.298	0.259	-.026	0.461	0.294	0.366
18	0.065	-.675	-.500	0.128	0.107	-.843	-.062	-.023	0.726
19	-.030	-.814	-.259	0.237	-.073	-.863	0.193	-.000	0.787
20	0.357	0.261	0.150	0.201	0.273	0.255	0.136	0.317	0.259
26	0.355	0.154	0.162	0.513	0.191	0.104	0.246	0.576	0.440
27	-.195	-.258	0.141	-.510	-.119	-.036	0.097	-.599	0.384
28	-.269	0.249	0.103	0.397	-.351	0.166	-.040	0.386	0.303
30	0.828	-.011	-.048	-.297	0.858	0.046	0.148	-.126	0.776
Sum of squared factor loadings:					3.545	1.651	1.680	1.412	
Variance accounted by factors:					0.236	0.110	0.112	0.094	

A - Communality obtained.

in tables :Table 7a - 7c. The first three eigen roots accounted 46.66 per cent of the variability and the first four accounted for 53.8 per cent.

The characters dominant in vectors of Table 7c are given below :

Vector I :- Number of flowers produced (8)
Kernel yield per plant (30)
Number of mature pods per plant (10)
Duration of flowering (9)
Number of immature pods (12)

Vector II :- Duration to maturity (19)
Number of days to 50 percentage flowering (18)

Vector III :- Total number of branches per plant (18)
Leaf area at harvest (6)

Vector III :- Driage percentage of pods (27)
Height of main shoot at harvest (26)
Hundred pod weight (14)

The results of the principal component analysis with the genotypic correlation matrix of order 15 were provided in tables : Table 8a - 8c. The first three roots accounted for 57.61 percent of the variance and the first four roots accounted for 68.72 per cent. The last eigen root of the genotypic correlation matrix of order 15 was negative (-.143) which is very small in magnitude, and may be due to numerical errors. Under this assumption, principal component analysis

Table 8a. Latent roots of the genetic correlation matrix of order 15 of data A.

Sl. No.	Latent Roots	Contribution to variance
1	3.792	25.28
2	2.824	18.83
3	2.025	13.50
4	1.666	11.11
5	1.065	7.10
6	0.968	6.45
7	0.714	4.76
8	0.567	3.78
9	0.433	2.88
10	0.368	2.45
11	0.344	2.29
12	0.210	1.40
13	0.116	0.77
14	0.051	0.34
15	-.143	-.95

Table 8b. The latent vectors corresponding to first four latent roots of Table 8a.

Variable code	Latent vectors 1	2	3	4
4	0.231	0.463	0.073	-.003
6	-.074	-.027	-.170	0.534
8	0.167	0.183	-.434	0.221
9	0.095	0.072	-.484	-.054
10	0.330	-.366	-.021	0.171
12	0.227	-.228	0.455	-.055
14	-.296	0.275	0.166	0.035
17	0.196	0.437	0.235	0.271
18	0.380	0.361	-.015	-.082
19	0.281	0.291	0.094	0.038
20	-.487	0.044	0.001	0.188
26	-.252	0.207	0.335	0.281
27	0.049	-.167	0.236	0.348
28	-.008	0.056	0.221	-.483
30	0.303	-.253	0.165	0.276

Table 8c. Component loadings and rotated loadings of the four latent vectors of Table 8b.

Variable code	Component loadings 1	2	3	4	Rotated loadings 1	2	3	4	A
4	0.450	0.779	0.103	-.004	0.114	0.885	-.122	-.095	0.820
6	-.145	-.045	-.242	0.692	-.085	-.078	-.014	0.740	0.561
8	0.326	0.308	-.617	0.285	0.161	0.351	-.572	0.431	0.663
9	0.185	0.121	-.688	-.069	0.186	0.065	-.686	0.133	0.527
10	0.642	-.616	-.029	0.221	0.864	-.056	0.201	0.225	0.841
12	0.443	-.383	0.647	-.070	0.479	0.091	0.678	-.264	0.767
14	-.577	0.462	0.237	0.045	-.768	0.052	0.106	-.031	0.645
17	0.381	0.735	0.334	0.349	0.196	0.899	0.203	0.175	0.919
18	0.740	0.607	-.022	-.105	0.241	0.892	-.220	-.155	0.927
19	0.547	0.490	0.134	0.050	0.124	0.736	0.001	-.043	0.559
20	-.947	0.074	0.001	0.243	0.808	-.486	0.054	0.265	0.962
26	-.491	0.348	0.477	0.363	-.685	0.105	0.448	0.199	0.721
27	0.096	-.281	0.336	0.450	0.167	-.033	0.512	0.334	0.403
28	-.015	0.094	0.314	-.624	-.086	0.041	0.087	-.693	0.497
30	0.589	-.426	0.235	0.356	0.663	0.124	0.431	0.264	0.711
Sum of squared factor loadings:					3.356	3.344	2.074	1.710	
Variance accounted by factors:					0.224	0.223	0.138	0.114	

A - Community obtained.

was carried out. Unrotated loadings were found not giving any information on the nature of axes. The dominant characters found according to the rotatdd loadings are as follows.

Axis I :- Number of mature pods per plant (10)
Plant height on 50th day (20)
Hundred pod weight (14)
Height of main shoot at harvest (26)
Kernel yield per plant (30)

Axis II :- Haulm yield (17)
Days to 50 percentage flowering (18)
Total number of branches per plant (4)
Duration to maturity (19)

Axis III :- Duration of flowering (9)
Number of mature pods (12)
Total number of flowers produced (8)

Axis IV :- Leaf area at harvest (6)
Oil percentage (28).

4.1.5 Factor analysis.

Principal factor analysis was performed for the environment correlation matrix of order 23. Three factors and four factors were tried to extract. The results of principal factor solution when three factors were fitted are provided in Table 9. The pattern of factor loadings were clear even without rotation. The characters dominating in the factors were shown in an arrow diagram (fig. 1).

Table 9. Principal factor solution of the factor loadings, after 21 iterations, of the environment correlation matrix of order 23 of data A.

Variable code	Factor loadings 1	2	3	Rotated loadings 1	2	3	A	B
3	0.478	-.380	0.181	0.167	-.571	0.229	0.406	0.636
4	0.476	-.436	0.209	0.133	-.611	0.262	0.460	0.656
5	0.480	-.471	-.152	0.095	-.676	-.092	0.475	0.752
6	0.437	-.528	-.144	0.027	-.696	-.078	0.491	0.750
8	0.687	-.450	0.001	0.821	-.050	0.042	0.677	0.816
9	0.604	0.359	0.061	0.701	-.070	0.028	0.498	0.719
10	0.751	0.407	-.029	0.843	-.129	-.064	0.731	0.732
12	0.445	0.252	0.100	0.513	-.056	0.077	0.272	0.344
14	0.080	-.101	-.121	-.003	-.140	-.108	0.031	0.122
15	0.110	0.072	-.063	0.127	-.015	-.069	0.021	0.343
16	0.084	0.008	-.348	0.084	-.102	-.345	0.137	0.317
17	0.367	0.038	0.124	0.323	-.178	0.123	0.152	0.366
18	0.060	-.039	0.586	0.058	-.010	0.587	0.348	0.456
19	0.032	-.244	0.719	-.079	-.143	0.742	0.578	0.494
20	0.285	0.079	-.156	0.267	-.123	-.169	0.112	0.230
22	0.595	-.569	-.063	0.134	-.815	0.008	0.683	0.694
23	0.520	-.540	-.120	0.087	-.752	-.053	0.576	0.775
24	0.527	-.452	-.131	0.145	-.688	-.074	0.499	0.741
26	0.221	0.130	-.052	0.267	-.034	-.063	0.068	0.247
27	-.071	-.204	0.076	-.174	-.112	0.097	0.052	0.423
28	-.210	-.079	-.153	-.224	0.048	-.146	0.074	0.227
29	0.811	0.447	0.006	0.917	-.129	-.033	0.858	0.961
30	0.868	0.391	0.014	0.868	-.162	-.019	0.781	0.960
Sum of squared loadings:				4.189	3.530	1.264		
Var. accounted by factors:				0.182	0.153	0.055		

A - Communality in terms of sum of squared factor loadings.
B - Initial estimates of communality (squared multiple correlation coefficients).

Variable code	Variable	Factor loading		Percentage contribution* of the factor to the communality of variable	Factor
8	Total number of flowers produced	0.821	....	99.56	I
9	Duration of flowering ...	0.701	....	98.67	I
10	Number of mature pods per plant	0.843	....	97.22	I
12	Number of immature pods per plant	0.513	....	96.75	I
29	Pod yield per plant	0.917	....	98.00	I
30	Kernel yield per plant ..	0.868	....	96.41	I
3	Number of basal primary branches	-.571	....	80.03	II
4	Total number of branches per plant ...	-.611	....	81.15	II
5	Total number of leaves at harvest	-.676	....	96.20	II
6	Leaf area at harvest	-.696	....	98.66	II
22	Number of branches on 50th day	-.815	....	97.25	II
23	Number of leaves on 50th day	-.752	....	98.18	II
24	Leaf area on 50th day ..	-.688	....	94.86	II
18	Number of days to fity percentage flowering.	0.587	....	99.01	III
19	Duration ~~of flowering~~ to maturity ..	0.742	....	95.25	III

* Obtained by the formula "(squared factor loading)/communality"

Fig. 1. Arrow diagram showing the importance of characters on factars : Data A.

The values of communality obtained for the last two iterations are shown in appendix 5a. The last two successive solutions of communalities were found in agreement to fourth decimal place. Squared multiple correlation coefficients were taken as the initial values of communality. The initial and final values of communality were found to have large differences.

As the sum of squares of elements of eigen vectors ofa a correlation matrix are equal to unity, the sum of squared factor loadings were equal to the corresponding eigen values within numerical errors. As such this quantity expressed in terms of total variance will be equal to the variance explained by the factor.

When four factors were tried to fit the environment correlation matrix of order 23, twentifive iterations were taken for the convergence of communality solutions to 5 decimal points (Appendix 5a).

The factor loadings obtained were found to interpret without a rotation (Table 10). The final values of communality were found higly deviated from the initial values of communality-the squared multiple correlation coefficients. Almost all variables showed small loadings on factor four. None of the variables got higher loadings, in the fourth factor, even after the rotation.

Table 10. Principal factor solution of the factor loadings, after 25 iterations, of the environment correlation matrix of order 23 of data : four factor case.

Variable code	Factor loadings 1	2	3	4	Rotated loadings 1	2	3	4	A
3	0.498	-.388	0.249	-.355	0.111	-.594	0.262	-.391	0.587
4	0.485	-.430	0.252	-.209	0.106	-.614	0.285	-.242	0.528
5	0.485	-.459	-.142	-.213	0.068	-.678	-.099	-.194	0.511
6	0.443	-.516	-.130	-.201	0.005	-.696	-.080	-.170	0.520
8	0.683	0.465	0.027	0.155	0.840	-.003	-.014	-.010	0.707
9	0.601	0.373	0.041	0.168	0.725	-.053	0.012	0.025	0.530
10	0.743	0.420	-.028	-.063	0.815	-.117	-.085	-.218	0.733
12	0.441	0.261	0.102	-.097	0.485	-.050	0.059	-.204	0.283
14	0.082	-.101	-.120	0.051	0.010	-.139	-.100	0.067	0.034
15	0.111	0.077	-.039	-.340	0.062	-.024	-.088	-.353	0.136
16	0.123	0.010	-.351	-.024	0.080	-.103	-.349	0.000	0.139
17	0.377	0.049	0.167	-.359	0.263	-.183	0.123	-.428	0.301
18	0.061	-.037	0.587	0.260	0.109	0.006	0.611	0.179	0.417
19	0.034	-.232	0.677	0.105	-.052	-.130	0.709	0.050	0.525
20	0.283	0.084	-.160	0.018	0.267	-.118	-.165	-.013	0.113
22	0.598	-.550	-.064	0.076	0.166	-.797	0.020	0.075	0.670
23	0.543	-.561	-.166	0.339	0.163	-.774	-.052	0.353	0.752
24	0.552	-.474	-.179	0.371	0.227	-.709	-.074	0.372	0.699
26	0.219	0.135	0.048	-.100	0.228	-.003	-.074	-.141	0.079
27	-.069	-.213	0.061	0.300	-.115	-.109	0.118	0.323	0.144
28	-.209	-.083	-.147	-.068	-.115	0.041	-.143	-.009	0.077
29	0.801	0.458	0.002	0.016	0.901	-.115	-.052	-.157	0.852
30	0.785	0.404	0.033	0.106	0.875	-.144	-.034	-.061	0.791
Sum of squared factor loadings:					4.130	3.576	1.287	1.136	
Variance accounted by factors:					0.180	0.155	0.056	0.049	

A - Communality in terms of sum of squared factor loadings.

The variables having higher loading in order of magnitude on factors were:

Factor I :- Pod yield per plant (29)
Kernel yield per plant (30)
Total number of flowers produced (8)
Number of mature pods per plant (10)
Duration of flowering (9)

Factor II :- Total number of branches (22)
Total number of leaves at 50th day (23)
Leaf area on 50th day (24)
Leaf area at harvest (6)
Total number of leavestat harvest (5)
Total number of branches per plant (4)
Number of basal primary branches (3)

Factor III :- Days to 50 percentage flowering (18)
Duration to maturity (19).

Factor analysis was performed for the environment correlation matrix of the variable dimension 15. Fifty iterations were taken for the convergence of communality solutions to a four decimal point agreement. The 49th and 50th solutions of communalities are shown in appendix 5b.

The squared multiple correlations were taken as the initial values of communality. They were found quite different from the final values of communality. Even without factor rotation, the characters of importance in factors were identified.

Table 11. Principal factor solution of the factor loadings, after 50 iterations, for the environment correlation matrix of order 15 of data A.

Variable code	Factor loadings 1	2	3	Rotated loadings 1	2	3	A	B
4	0.288	-.463	-.585	0.131	-.183	-.768	0.640	0.317
6	0.183	-.224	-.449	0.081	-.020	-.528	0.290	0.277
8	0.859	0.091	0.198	0.884	-.049	0.047	0.785	0.792
9	0.748	0.031	0.166	0.763	-.083	0.015	0.589	0.689
10	0.845	0.095	0.041	0.846	0.023	-.088	0.724	0.078
12	0.521	-.038	0.007	0.507	-.006	-.111	0.273	0.298
14	0.006	0.008	-.128	-.012	0.061	-.112	0.016	0.082
17	0.348	-.100	-.192	0.298	-.027	-.280	0.168	0.279
18	0.063	-.576	0.366	0.042	-.680	0.078	0.470	0.412
19	-.033	-.800	0.242	-.100	-.823	-.107	0.700	0.431
20	0.288	0.137	-.094	0.286	0.148	-.083	0.111	0.156
26	0.281	0.058	-.098	0.268	0.079	-.119	0.092	0.169
27	-.151	-.120	-.070	-.175	-.070	-.082	0.042	0.234
28	-.215	0.121	-.018	-.197	0.129	0.076	0.061	0.162
30	0.798	0.012	0.012	0.785	-.037	-.139	0.637	0.675
Sum of squared factor loadings:				3.298	1.244	1.051		
Variance accounted by factors:				0.220	0.083	0.070		

A- Communality calculated in terms of the sum of squared factor loadings.

B -Initial estimates of communality (Squared multiple correlation coefficient)

The factor loadings are given in Table 11. The prominent characters that were found in factors:

Factor I :- Kernel yield per plant (30)
Total number of flowers produced (8)
Number of mature pods per plant (10)
Duration of flowering (9)

Factor II :- Duration to maturity (19)
Number of days to 50 percentage flowering (18)

Factor III :- Total number of branches per plant (4)
Leaf area at harvest (6)

Maximum correlations were taken as the initial values of communality for the principal factoranalysis with the genotypic correlation matrix of order 15. Twentifive iterations were taken for the convergence of communalities to fourth decimal point (appendix 5c). The factor loadings were found to very largely, when rotation was performed. The factor loadings are provided in Table 12. The characters that were dominant in the factors are:

Factor I :- Number of mature pods per plant (10)
Plant height on 50th day (20)
Hundred pod weight (14)
Kernel yield per plant (30)

Factor II :- Haulm yield (17)
Total number of branches per plant (4)
Days to 50 percentage flowering (18)

Factor III :- Number of immature pods per plant.

Table 12. Principal factor solution of the factor loadings, after 25 iterations, for the genotypic correlation matrix of order 15 of data A.

Variable code	Factor loadings			Rotated loadings				
	1	2	3	1	2	3	A	B
4	0.458	-.763	0.042	-.139	-.870	-.133	0.793	0.809
6	-.118	0.022	-.093	-.068	0.109	-.081	0.023	0.262
8	0.277	-.244	-.476	0.097	-.271	-.529	0.363	0.467
9	0.151	-.076	-.558	0.115	-.051	-.057	0.340	0.467
10	0.709	0.602	0.024	0.848	0.054	0.109	0.734	0.724
12	0.433	0.356	0.641	0.503	-.130	0.674	0.724	0.509
14	-.514	-.424	0.196	-.681	-.023	0.136	0.483	0.643
17	0.395	-.749	0.343	-.205	-.874	0.168	0.834	0.808
18	0.715	-.388	-.086	0.308	-.731	-.198	0.668	0.807
19	0.490	-.404	0.071	0.112	-.628	-.035	0.408	0.527
20	-.985	-.110	0.064	-.830	0.537	0.094	0.987	0.807
26	-.436	-.343	0.455	-.591	-.060	0.401	0.514	0.588
27	0.074	0.190	0.284	0.153	0.042	0.311	0.122	0.365
28	-.004	-.067	0.155	-.059	-.076	0.139	0.029	0.262
30	0.522	0.364	0.242	0.611	-.108	0.281	0.464	0.724
Sum of squared loadings:				3.072	2.870	1.545		
Var. accounted by factors:				0.205	0.191	0.103		

A - Communalities calculated in terms of the sum of squared factor loadings.

B - Initial estimates of communality : largest correlation coeffts.

4.1.6 Discriminant analysis.

The genetic distances between the populations were calculated based on 15 variable dimension and the values are presented in appendix 6. The latent roots of the between sum of product matrix of univariate uncorrelated variables (Y-variables) are given in Table 13a. The first two directions were sufficient to represent the whole data. The first three canonical vectors (of Y-variables) are provided in Table 13b. The first row of the inverse of transposed V-matrix (the triangular matrix used for the linear transformation of X-variables to Y-variables), the discriminant function coefficients of X-variables, and the standardised coefficients are given in Table 13c.

The characters, leaf area at harvest (6), haulm yield (17), height of main shoot at harvest (26) were found to have maximum contribution towards divergence. The standard weights of these characters were also found high in the same order of magnitude. The standard weight of leaf area at harvest was found very large in magnitude.

A discriminant function with all the variables, excluding the variable (21), showed that the characters leaf area at harvest (6), hundred pod weight (14), leaf area at 50th day (24), height of main shoot at harvest (26), total number of flowers produced (8) and length of top at harvest (2) were contributing maximum towards divergence. (The results of this analysis were not presented)

Table 13a. Latent roots of between sum of product matrix of transformed (Y) variables: data A.

Sl. No.	Latent Roots	Contribution to variance
1	904.63	74.23
2	151.95	12.47
3	53.80	4.41
4	37.65	3.09
5	28.11	2.31
6	13.13	1.08
7	7.78	0.64
8	6.50	0.53
9	3.87	0.32
10	3.05	0.25
11	2.42	0.20
12	1.89	0.15
13	1.72	0.14
14	1.40	0.12
15	0.75	0.06

Table 13b. Latent vectors corresponding to the first three latent roots of Table 13a.

Variable code	Latent vectors 1	2	3
4	0.010	0.013	0.142
6	-.009	0.040	-.134
8	-.023	-.050	0.060
9	0.027	0.969	0.084
10	-.045	0.010	-.125
12	0.005	0.126	-.073
14	0.955	-.011	-.105
17	0.075	0.039	0.070
18	-.002	0.034	0.038
19	0.150	0.134	0.529
20	0.141	0.051	-.011
26	0.080	0.121	-.061
27	0.046	-.036	-.781
28	0.036	-.040	-.017
30	-.164	0.025	0.133

Table 13c. Coefficients of discriminant function.

First row of Inv(V')	Varibale code	Canonical vector corresponding to original (X) variables.	Standard weights
1.696	4	0.0168	0.0284
184.534	6	-1.7217	-718.8556
1.925	8	-.0439	-.6587
0.238	9	0.0063	0.0143
0.647	10	-.0288	-.1152
0.133	12	0.0007	0.0001
0.103	14	0.0979	0.1408
4.729	17	0.3586	6.4586
0.257	18	-0.0006	-.0011
0.323	19	0.0485	0.0958
0.472	20	0.0665	0.4071
1.484	26	0.1185	1.2378
0.152	27	-.0071	-.0122
-.341	28	-.0123	-.0428
0.426	30	-.0701	-.1574

V' - The transpose of the triangular matrix used for the univariate uncorrelated transformation in discriminant analysis.

Table 14. Varietal means according to the first two canonical variates : data A.

Code Number	Canonical axis 1	2	Code Number	Canonical axis 1	2
1	76.71	-36.57	32	83.16	-29.66
2	115.47	-32.70	33	98.93	-22.40
3	130.66	-20.69	34	104.82	-34.82
4	124.15	-15.95	35	98.20	-23.53
5	87.99	-12.18	36	80.55	-38.49
6	130.24	-33.88	37	148.04	-24.35
7	151.31	-61.30	38	115.80	-24.47
8	132.57	-26.65	39	119.93	334.82
9	94.82	-32.21	40	88.80	-32.43
10	88.22	-28.97	41	104.66	-22.55
11	90.07	-28.76	42	86.42	-34.24
12	124.91	-38.76	43	125.95	-25.90
13	97.61	-24.41	44	139.58	-31.67
14	93.93	-28.88	45	66.33	-29.84
15	69.66	-15.52	46	96.80	- 9.58
16	83.62	-23.98	47	110.34	-14.79
17	108.54	-18-57	48	90.05	-33.52
18	107.45	-28.60	49	111.65	-26.13
19	93.09	-29.70	50	90.28	-23.89
20	108.83	-13.67	51	94.71	-16.97
21	102.05	-24.46	52	88.58	-20.65
22	128.93	-19.18	53	96.94	-24.72
23	91.55	-21.13	54	100.49	-22.86
24	96.13	-33.98	55	100.98	-22.46
25	87.91	-34.81	56	122.02	- 8.77
26	100.71	-27.44	57	103.76	-22.81
27	92.59	221.89	58	103.25	-23.83
28	107.11	-31.95	59	990.29	-21.61
29	123.63	-32.84	60	90.17	-16.64
30	102.88	-19.84	61	91.91	-34.45
31	95.76	-28.20	62	95.56	-22.82

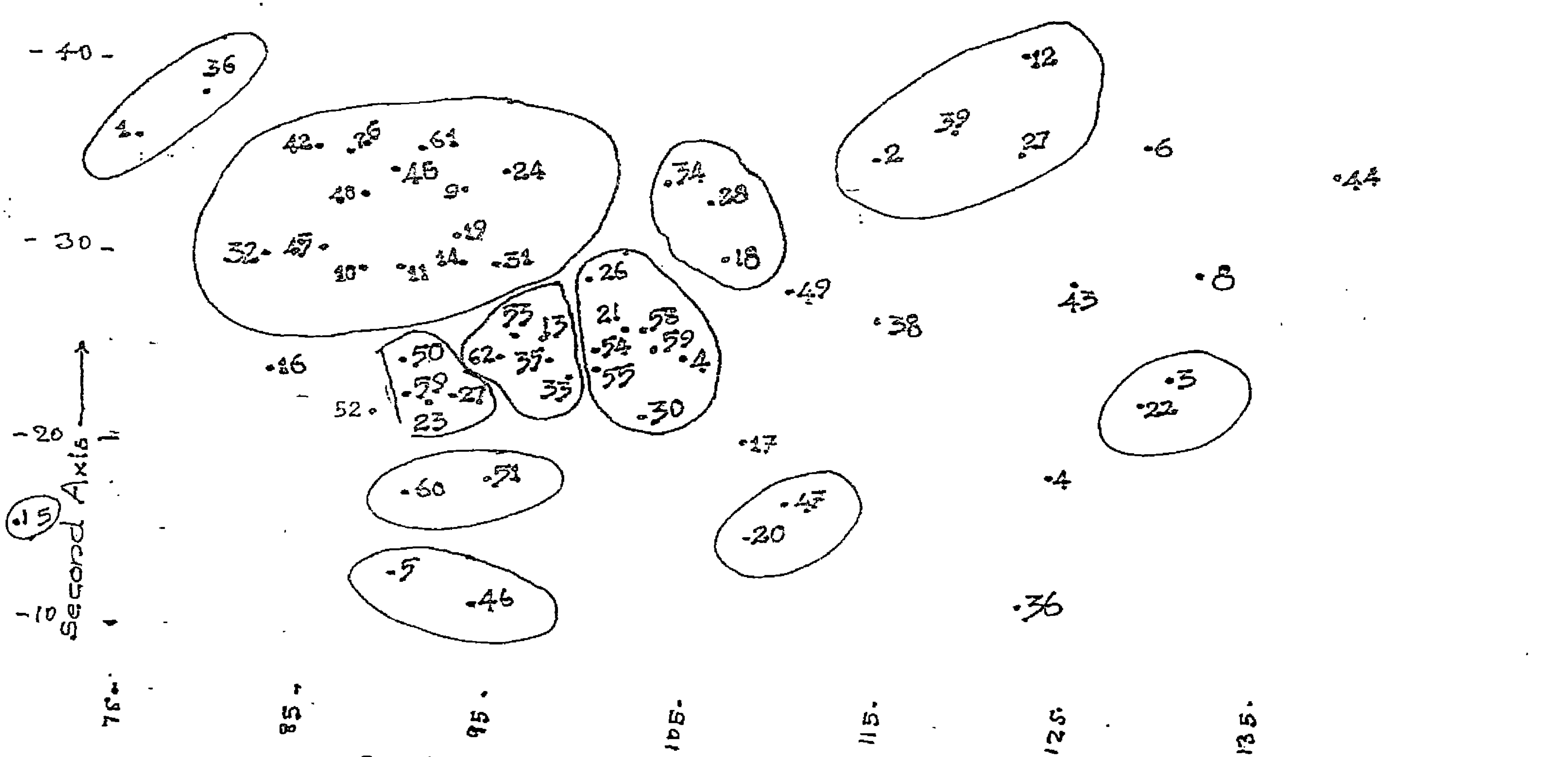

Fig: 2 Scatter diagram showing the positions of 62 varieties of Groundnut on the basis of first two canonical variates - data A

As the two canonical variates explained about 66.7 per cent of total variance, the two canonical directions were quite enough to represent the genotypes. The mean values of genotypes are presented in Table 14, for these two canonical axes. The genotypes were ploted according to these directions (fig. 2). Contiguous points were grouped into clusters intuitively.

The dendrogram for the weighted average link method of heirarchical method of clustering were shown in fig. 3.

4.2 Results of data B

4.2.1 Preliminary statistical analysis.

As in the case of data, the total dispersion was partitioned into replication, between, and within dispersions. The between and within dispersions are given in appendix 7 & 8.

The F-values for testing the equality of variety means w were given in Table 15. All the F-values were found significant at one percent level, except the value corresponding to the character plant spread on 50th day (21), which is significant only at 5 per cent level.

The value of Wilk's lambda statistic is

$$\Lambda = 8.01106 \times 10^{-26}$$

so that

$$- m \log_e \Lambda = 12497.64,$$

Table 15. The F-values obtained from the character-wise RBD-Anova of data B.

	Variables	F-values
1	Dry pod yield	1.814
2	Length of top on harvest	2.765
3	Number of basal primary branches	4.051
4	Total number of branches per plant	4.741
5	Total number of leaves at harvest	4.865
6	Leaf area at harvest	5.482
7	Leaf area index at harvest	5.342
8	Total number of flwoers produced	4.995
9	Duration of flowering	30.364
10	Number of mature pods per plant	2.509
11	Percentage of pod set	9.231
12	Number of immature pods per plant	2.972
13	Ratio of mature to immature pods	2.301
14	Hundred pod weight (dry)	2188.152
15	Hundred kernel weight	226.510
16	Shelling percentage	48.607
17	Haulm yield	2.058
18	Days to fifty percentage flowering	6.924
19	Duration of maturity	13.178
20	Plant height of 50th day	2.076
21	Plant spread on 50th day	1.431^{+}
22	Number of branches on 50th day	4.281
23	Number of leaves on 50th day	2.864
24	Leaf area on 50th day	2.748
25	Leaf area index on 50th day	2.758
26	Height of main shoot at harvest	2.736
27	Driage percentage of pods	41.263
28	Oil percentage	90.336
29	Pod yield per plant	1.821
30	Kernel yield per plant	2.777

$^{+}$Significant at 5% level. All others are significant at 1% level.

a chi-square with degrees of freedom 1830, which is highly significant. The varietal means were arranged in appendix 9.

4.2.2 Estimated genotypic covariances.

The genotypic covariance matrix is estimated and the genotypic correlation matrix along with standard deviations are provided in appendix 10.

As in the case of data A, the estimated values of genotypic correlation between certain characters were found exceeding unity. The genotypic correlation of characters number of basal primary branches and total number of branches per plant (3 & 4), with total number of branches on 50th day (22) and total number of leaves on 50th day (23) were found more than unity. Further the genotypic correlation b between the characters number of basal primary branches with total number of branches per plant, number of branches on 50th day with number of leaves on 50th day, and total number of leaves at harvest (5) with number of leaves on 50th day were found nearly one, and between the characters leaf area at harvest with leaf area index at harvest (7) and leaf area on 50th day (24) with leaf area index on 50th day (25) equal to unity. The genotypic correlation of (6) and (7) with (24) and (25) were also found neqr to unity. These results were in resemblence with the results of data A.

4.2.3 Reduced dimensions and discarded variables.

The eigen roots of the within correlation matrix are shown in Table 16a. The last four roots were found very small in magnitude and they contributed only 0.16 per cent towards the variance. The eigen vectors corresponding to the last four latent roots are provided in Table 16b.

The variable leaf area index on 50th day (25) had got a large coefficient on the last vector. Though the sixth character leaf area at harvest got large coefficient in the 29th vector, the variable with the second largest coefficient leaf area index at harvest (7) is discarded. In the 28th vector, the character pod yield (1) showed largest coefficient. Number of leaves at 50th day got high value in the 27th vector. Hence the characters (1), (7), (23), and (26) were discarded. Further the characters percentage of pod set, ratio of mature to immature pods and plant spread on 50th day were also discarded.

The The environment correlation matrix of the reduced variable dimension of size 23 was subjected principal component analysis and factor analysis. The variable dimension was later reduced to 15 by discarding eight more variables. The same variables that were kept for 15 variable dimension of data A were kept in the dimension 15 of data B. The variables kept in the dimensionality 15 are (4), (6), (8), (9), (10), (12), (14), (17), (18), (19), (20), (26), (27), (28), and (30).

4.2.4 Principal component analysis.

Principal component analysis was performed with the environment correlation matrix of order 23, environment correlation

Table 16a. Eigen roots of the within correlation matrix of the data B.

Sl. No.	Latent Roots	Contribution to variance.
1	8.6993	29.00
2	3.0636	10.21
3	2.3364	7.79
4	2.1654	7.22
5	1.9518	6.51
6	1.7728	5.91
7	1.3184	4.39
8	1.1770	3.92
9	1.1183	3.73
10	1.0413	3.47
11	0.8806	2.94
12	0.7482	2.49
13	0.6178	2.06
14	0.5048	1.68
15	0.3909	1.30
16	0.3404	1.13
17	0.3217	1.07
18	0.2940	0.98
19	0.2445	0.82
20	0.2038	0.68
21	0.1987	0.66
22	0.1740	0.58
23	0.1590	0.53
24	0.1240	0.41
25	0.0717	0.24
26	0.0351	0.12
27	0.0278	0.09
28	0.0122	0.04
29	0.0046	0.02
30	0.0018	0.01

Table 16b. Latent vectors corresponding to the last four roots of Table 16a.

Variable code	Latent vectors 27	28	29	30
1	0.090	0.777	0.027	-0.015
2	0.052	-.013	0.014	-.002
3	0.150	0.021	0.001	-.003
4	-.145	-.032	-.002	-.020
5	0.353	0.006	0.062	-.059
6	-.145	0.004	-.734	0.041
7	-.237	-.014	0.673	0.012
8	0.020	0.019	0.003	-.004
9	0.031	-.011	-.003	-.005
10	-.004	-.074	-.012	0.012
11	-.000	0.033	-.001	-.008
12	0.007	0.012	-.021	0.001
13	-.012	0.012	-.012	-.003
14	0.002	0.060	0.005	0.003
15	-.012	-.036	0.003	0.001
16	0.004	0.013	-.007	-.001
17	-.044	0.023	-.011	0.002
18	-.070	-.022	-.010	0.008
19	0.037	-.000	-.000	-.002
20	-.037	0.004	-.004	-.000
21	-.012	-.012	-.0000	0.000
22	-.032	-.016	-.010	-.013
23	-.653	0.074	-.011	0.047
24	0.408	-.012	0.034	0.689
25	0.307	-.034	-.005	-.719
26	-.013	-.013	0.001	-.004
27	0.020	-.064	0.011	-.005
28	-.048	-.016	0.007	0.006
29	0.087	-.584	0.020	0.010
30	-.184	-.169	-.026	0.008

matrix of order 15 and genotypic correlation matrix of order 15.

The results of principal component analysis for the environment correlation matrix of order 23 are given in Table 17a to Table 17c. The first three eigen roots accounted for 46.7 per cent of total variance and the first four eigen roots accounted for 56.15 per cent (Table 17a).

The eigen vectors corresponding to the first four roots of the matrix are given in Table 17b, and the component loadings in Table 17c. Rotated and unrotated loadings showed large differences in their pattern. The important characters of factors of Table 17c are given below:

Axis I :- Total number of branches per plant (4)
Number of basal primary branches (3)
Total number of leaves at harvest (5)
Leaf area at harvest (6)
Total number of branches at 50th day (22)
Leaf area on 50th day (24)

Axis II :- Pod yield per plant (29)
Kernel yield per plant (3)
Total number of flowers produced (8)
Duration of flowering (10)
Number of mature pods per plant (10)

Axis III :- Height of main shoot at harvest (26)
Length of top (2)
Plant height on 50th day (20)

Table 17a. Latent roots, omitting 7 variables, of the within correlation matrix of data B.

Sl. No.	Latent roots	Percent contribution to variance
1	6.380	27.74
2	2.747	11.94
3	2.115	9.19
4	1.945	8.46
5	1.505	6.54
6	1.279	5.56
7	1.062	4.62
8	1.033	4.49
9	0.846	3.68
10	0.724	3.15
11	0.702	3.05
12	0.548	2.38
13	.511	2.22
14	0.329	1.43
15	0.264	1.15
16	0.235	1.02
17	0.206	0.90
18	0.188	0.82
19	0.172	0.75
20	0.165	0.72
21	0.155	0.67
22	0.046	0.20
23	0.032	0.14

Table 17b. The latent vectors corresponding to the first fowr latent roots of Table 17a.

Variable code	Latent vectors 1	2	3	4
2	0.181	-.509	-.059	-.183
3	0.272	-.235	0.180	0.218
4	0.283	-.248	0.108	0.232
5	0.261	-.284	0.043	0.085
6	0.285	-.293	0.027	0.049
8	0.288	0.281	0.041	-.137
9	0.202	0.317	0.108	-.141
10	0.272	0.196	0.134	-.108
12	0.185	-.023	0.086	-.067
14	-.007	-.204	0.158	0.452
15	0.015	-.144	0.148	-.361
16	0.028	-.015	-.102	-.124
17	0.243	0.045	-.042	-.155
18	-.051	-.328	0.079	-.354
19	-.051	-.327	0.144	-.324
20	0.147	-.066	-.507	0.076
22	0.223	-.147	0.104	0.268
23	0.263	-.171	-.047	0.110
26	0.139	-.055	-.523	-.210
27	-.074	0.024	0.023	-.069
28	0.010	0.077	-.014	0.127
29	0.315	0.268	0.105	-.148
30	0.300	0.279	0.119	-.139

Table 17c. Component loadings and rotated loadings of the four latent vectors of Table 17b.

Variable code	Component loadings 1	2	3	4	Rotated loadings 1	2	3	4	A*
2	0.459	-.094	-.740	-.255	0.159	0.155	-.834	-.019	0.831
3	0.688	-.370	0.262	0.304	0.854	0.182	0.096	0.001	0.771
4	0.714	-.391	0.157	0.324	0.876	0.153	-.003	0.036	0.792
5	0.711	-.447	0.063	0.119	0.809	0.169	-.151	-.129	0.723
6	0.719	-.461	0.040	0.068	0.799	0.178	-.190	-.171	0.736
8	0.727	0.442	0.060	-.191	0.185	0.834	-.157	0.104	0.765
9	0.509	0.499	0.157	-.196	0.013	0.750	-.004	0.092	0.572
10	0.687	0.308	0.195	-.150	0.270	0.743	-.025	0.024	0.627
12	0.468	-.036	0.125	-.094	0.328	0.351	-.047	-.107	0.245
14	-.018	-.321	0.230	-.630	-.047	0.079	0.008	-.738	0.553
15	0.038	-.226	0.215	-.504	-.014	0.124	0.023	-.580	0.353
16	0.071	-.024	-.148	-.173	-.029	0.058	-.206	-.104	0.057
17	0.615	0.070	-.061	-.217	0.291	0.512	-.281	-.087	0.434
18	-.128	-.517	0.115	-.493	0.027	-.191	-.047	-.707	0.540
19	-.128	-.515	0.209	-.452	0.056	-.182	0.050	-.701	0.530
20	0.372	-.104	-.737	0.106	0.250	-.038	-.758	0.256	0.704
22	0.563	-.232	0.151	0.374	0.699	0.131	0.062	0.155	0.534
24	0.666	-.269	-.068	0.153	0.670	0.202	-.231	0.028	0.544
26	0.352	-.087	-.761	-.293	0.061	0.098	-.884	-.045	0.797
27	-.186	0.039	0.033	-.097	-.186	-.056	0.059	-.074	0.047
28	0.025	0.122	-.020	0.177	0.016	0.022	0.036	0.213	0.047
29	0.797	0.422	0.153	-.206	0.253	0.895	-.098	0.058	0.879
30	0.757	0.438	0.172	-.194	0.223	0.880	-.064	0.069	0.833
Sum of squared factor loadings:					4.274	4.081	2.436	2.121	
Variance accounted by factors:					0.186	0.177	0.106	0.092	

*A - Communality obtained.

Axis IV :- Hundred pod weight (14)
Days to fifty percentage flowering (18)
Duration to maturity (19)

The eigen roots of the genotypic correlation matrix of order 23 are shown in Table 18. The matrix was found to be in indefinite form and hence principal component analysis was not performed for his matrix.

The results of principal component analysis with the environment correlation matrix of order 15 are presented in tables: Table 19a - 19c. The first three eigen roots accounted for 50.51 per cent of total variance and the first four accounted for 58.81 per cent. The eigen vectors corresponding to the first four roots are shown in Table 19b. The principal component loadings and the varimax rotated loadings are given in Table 19c.

Rotated and unrotated loadings exhibhited almost same loading pattern. Even without rotation the vectors can be interpreted. The dominant characters in the axes are as follows:

Axis I :- Kernel yield per plant (30)
Total number of flowers produced (8)
Number of mature pods per plant (10)
Duration of flowering (10)

Axis II :- Days to 50 percentage flowering (18)
Duration to maturity (19)

Table 18. Eigen roots of genotypic correlation matrix of order 23 of data B.

Sl. no.	Latent roots
1	6.214
2	4.077
3	3.136
4	2.024
5	1.369
6	1.324
7	1.121
8	1.033
9	0.951
10	0.641
11	0.485
12	0.399
13	0.318
14	0.201
15	0.107
16	0.092
17	0.040
18	0.007
19	0.004
20	-.019
21	-.063
22	-.086
23	-.321

Table 19a. Latent roots of environment correlation matrix of order 15 of data B.

Sl. No.	Latent Roots	Contribution to variance.
1	4.037	26.92
2	1.961	13.07
3	1.577	10.52
4	1.244	8.30
5	1.132	7.54
6	0.955	6.37
7	0.905	6.03
8	0.837	4.91
9	0.626	4.17
10	0.487	3.25
11	0.366	2.44
12	0.329	2.19
13	0.246	1.64
14	0.201	1.34
15	0.197	1.31

Table 19b. The eigen vectors corresponding to the first four eigen roots of Table 19a.

Variable code	Eigen vectors 1	2	3	4
4	0.295	-.158	0.174	0.461
6	0.292	-.266	0.242	0.317
8	0.409	0.060	-.164	-.182
9	0.320	0.106	-.290	-.196
10	0.369	-.052	-.226	-.119
12	0.244	-.127	-.048	0.332
14	-.012	-.342	-.094	0.221
17	0.319	-.102	0.018	-.066
18	-.119	-.593	-.065	-.252
19	-.122	-.585	-.108	-.128
20	0.166	0.048	0.592	-.301
26	0.174	-.107	0.515	-.359
27	-.089	-.028	-.205	-.250
28	0.017	0.183	0.041	0.228
30	0.406	0.017	-.250	-.159

Table 19c. Component loadings and rotated loadings of the four latent vectors of Table 19b.

Vari-able code	Component loadings 1	2	3	4	Rotated loadings 1	2	3	4	A*
4	0.593	-.221	0.219	0.514	0.227	0.063	0.077	0.807	0.712
6	0.587	-.372	0.304	0.353	0.228	-.112	0.229	0.764	0.700
8	0.823	0.084	-.206	-.203	0.847	0.108	0.141	0.137	0.767
9	0.644	0.149	-.364	-.218	0.776	0.114	-.028	-.030	0.617
10	0.741	-.072	-.284	-.132	0.785	-.041	0.023	0.183	0.653
12	0.489	-.178	-.060	0.371	0.312	0.004	-.108	0.551	0.412
14	-.023	-.479	-.118	0.247	-.063	-.397	-.220	0.309	0.305
17	0.641	-.142	0.023	-.073	0.542	-.057	0.222	0.300	0.436
18	-.240	-.831	-.082	-.281	-.109	-.905	0.028	-.050	0.834
19	-.245	-.820	-.135	-.142	-.132	-.863	-.088	0.031	0.770
20	0.333	0.068	0.744	-.335	0.051	0.128	0.866	0.107	0.781
26	0.350	-.150	0.646	-.400	0.121	-.106	0.827	0.114	0.723
27	-.179	-.039	-.258	-.279	0.053	-.183	-.117	-.357	0.177
28	0.035	0.257	0.052	0.254	-.063	0.326	-.081	0.131	0.134
30	0.816	0.024	-.314	-.177	0.880	0.042	0.038	0.141	0.797
Sum of squared factor loadings:					3.262	1.936	1.653	1.970	
Variance accounted by factors:					0.217	0.129	0.110	0.131	

*A - Communality obtained.

Axis III :- Plant height on 50th day (20)
Height of main shoot at harvest (26)

Axis IV :- Total number branches per plant (4)
Leaf area at harvest (6).

The eigen roots of the genotypic correlation matrix of order 15 are shown in Table 20a. Two the eigen roots were found negative (-.005 and -.064). These two roots are negligible in magnitude, and thus principal component analysis was performed with this matrix. The first three roots were found to account for 59.52 per cent, and the first four roots 69.14 per cent of the total variation. The eigen vectors corresponding to the first four roots are given in Table 20c.

Rotation was found helpful for isolating the important characters of factors. They are:

Factor I :- Haulm yield (17)
Leaf area at harvest (6)
Duration to maturity (19)
Total number of branches per plant (4)
Number of immature pods per plant (12)
Height of main shoot at harvest (26)

Factor II :- Plant height on 50th day (20)
Days to 50 percentage flowering (18)
Hundred pod weight (14)

Factor III :- Kernel yield per plant (30)
Driage percentage of pods (27).

Table 20a. The characteristic roots of the genotypic correlation matrix of order 15 of data B.

Sl. No.	Latent Roots	Contribution to variance.
1	4.108	27.39
2	2.982	19.88
3	1.838	12.25
4	1.443	9.62
5	1.262	7.80
6	0.819	5.46
7	0.729	4.86
8	0.663	4.42
9	0.474	3.16
10	0.357	2.38
11	0.263	1.75
12	0.126	0.84
13	0.104	0.69
14	-0.005	-.03
15	-0.064	-.43

Table 20b. Latent vectors corresponding to the first four characteristic roots of Table 20a.

Variable code	Latent vectors 1	2	3	4
4	0.361	-.097	0.271	0.135
6	0.398	0.076	-.053	0.268
8	-.027	0.088	0.143	0.625
9	-.043	0.274	0.151	0.371
10	0.231	-.375	-.211	0.127
12	0.323	0.108	-.049	-.166
14	0.044	0.468	0.048	-.228
17	0.362	0.230	0.120	0.221
18	0.276	-.331	0.197	0.022
19	0.393	0.022	-.024	-.143
20	-.047	0.405	-.397	0.037
26	0.259	0.279	-.312	-.049
27	-.204	-.231	-.376	0.336
28	0.181	-.197	-.024	-.301
30	0.170	-.120	-.617	0.088

Table 20c. Component loadings and rotated loadings of the latent vectors of Table 20b.

Vari-able code	Component loadings 1	2	3	4	Rotated loadings 1	2	3	4	A
4	0.731	-.168	0.368	0.162	0.668	-.517	0.077	0.069	0.725
6	0.806	0.131	-.072	0.322	0.832	-.079	-.209	0.186	0.776
8	-.054	0.152	0.194	0.751	0.043	-.098	-.071	0.782	0.628
9	-.086	0.473	0.204	0.446	0.079	0.206	0.300	0.617	0.472
10	0.469	-.648	-.286	0.153	0.282	-.476	-.627	-.215	0.745
12	0.656	0.186	-.067	-.200	0.666	0.077	0.043	-.241	0.509
14	0.090	0.842	0.065	-.274	0.298	0.653	0.530	0.024	0.797
17	0.773	0.397	0.163	0.266	0.870	0.017	0.123	0.285	0.853
18	0.560	-.572	0.267	0.027	0.383	-.721	-.113	-.180	0.712
19	0.797	0.038	-.033	-.172	0.762	-.092	-.022	-.277	0.667
20	-.095	0.700	-.538	0.044	0.101	0.863	-.120	0.143	0.790
26	0.525	0.482	-.423	-.059	0.630	0.513	-.149	-.088	0.690
27	-.413	-.398	-.599	0.404	-.479	-.009	-.701	0.174	0.751
28	0.367	-.341	-.032	-.362	0.233	-.269	-.073	-.501	0.383
30	0.345	-.207	-.837	0.106	0.278	0.211	-.834	-.234	0.872
Sum of squared factor loadings:					4.010	2.640	2.030	1.691	
Variance accounted by factors:					0.267	0.176	0.135	0.113	

A - Communality obtained.

Factor IV :- Total number of flowers produced (8)
Duration of flowering.

4.2.5 Factor analysis.

As in the case of Data A, three factors and four factors were fitterd to the environment correlation matrix of order 23. Squared multiple correlations were taken as the initial estimates of communality.

The results of principal factor solution for the environment correlation matrix, when three factors extracted were given in Table 21. After 22 iterations, the values of communalities were converged to four decimal places (appendix 11a)

Rotation was found helpful in interpreting the factors. The important characters of factors were as follows:

Factor I :- Number of branches per plant (4)
Number of basal primary branches (3)
Leaf area on 50th day (24)
Number of branches on 50th day (22)

Factor III :- Pod yield per plant (29)
Kernel yield per plant (30)
Number of flowers produced (8)
Duration of flowering (9)
Number of mature pods per plant (10)

Factor III :- Length of top (2)
Height of main shoot at harvest (26)
Plant height on 50th day (20).

Table 21. Principal factor solution of the factor loadings, after 22 iterations, of the environment correlation matrix of order 23 of data B.

Variable code	Factor loadings 1	Factor loadings 2	Factor loadings 3	Rotated loadings 1	Rotated loadings 2	Rotated loadings 3	A	B
2	0.459	-.131	-.773	0.145	0.103	-.891	0.826	0.683
3	0.676	-.387	0.337	0.848	0.047	0.030	0.721	0.720
4	0.702	-.429	0.250	0.857	0.022	-.066	0.739	0.767
5	0.700	-.451	0.119	0.819	-.002	-.898	0.708	0.911
6	0.708	-.456	0.088	0.816	-.003	-.224	0.717	0.909
8	0.717	0.451	-.017	0.323	0.763	-.177	0.718	0.733
9	0.479	0.445	0.057	0.167	0.634	-.030	.431	0.473
10	0.658	0.320	0.105	0.388	0.626	-.065	0.547	0.591
12	0.421	-.014	0.062	0.358	0.215	-.081	0.151	0.314
14	-.016	-.131	0.050	0.072	-.117	0.030	0.020	0.504
15	0.032	-.082	0.058	0.088	-.050	0.030	0.011	0.444
16	0.061	-.016	-.108	0.017	0.015	-.123	0.016	0.164
17	0.568	0.073	-.091	0.373	0.362	-.258	0.337	0.456
18	-.111	-.253	0.005	0.045	-.273	-.001	0.077	0.658
19	-.111	-.249	0.076	0.068	-.266	0.066	0.080	0.650
20	0.350	-.174	-.554	0.161	0.018	-.658	0.459	0.553
22	0.518	-.212	0.196	0.584	0.106	-.021	0.352	0.711
24	0.623	-.235	-.010	0.602	0.134	-.251	0.443	0.734
26	0.345	-.107	-.755	0.050	0.064	-.832	0.700	0.627
27	-.163	0.048	0.008	-.149	-.046	0.069	0.029	0.313
28	0.021	0.058	0.009	-.007	0.056	0.010	0.003	0.145
29	0.812	0.500	0.067	0.402	0.858	-.121	0.914	0.946
30	0.762	0.498	0.087	0.371	0.831	-.087	0.836	0.924
Sum of squared loadings:				4.435	3.196	2.234		
Var. accounted by factors:				0.193	0.139	0.097		

A - Communality in terms of sum of squared factor loadings.

B- Initial estimates of communality (squared multiple correlation coefficients).

The results of principal factor solution for four factors are summarized in Table 22. The arrow diagram showing the relative importance of characters on factors are shown in fig. 4.

The last two slutions of communalities are shown in appendix 11a.

Three factors were extracted from the environment correlation matrix of order 15. Sixty iterations were taken for the convergences of solutions of communalities to four decimal places (appendix 11b). The factor loadings were provided in Table 23. Without factor rotation, important characters of factors, were able to isolate. They are:

Factor I :- Kernel yield per plant (30)
Number of flowers produced (8)
Number of mature pods per plant (10)
Duration of flowering (9)

Factor II :- Duration to maturity (19)
Days to 50 percentage flowering (18)

Factor III :- Leaf area at harvest (6)
Number of branches per plant (4)
Plant height on 50th day (20)
Height of main shoot at harvest (26)

The results of factor analysis with genotypic correlation matrix are presented in Table 24. As in the case of data A, largest correlations were taken as the initial values of communalities. The character kernel yield per plant (30)

Table 22. Principal factor solution of factor loadings, after 35 iterations, of the environment correlation matrix of order 23 of data B: four factor case.

Variable code	Factor loadings 1	2	3	4	Rotated loadings 1	2	3	4	A
2	0.461	-.151	-.703	-.145	0.133	0.148	-.843	-.033	0.751
3	0.671	-.353	0.350	0.196	0.840	0.176	0.057	-.018	0.739
4	0.701	-.389	0.266	0.265	0.873	0.155	-.026	0.045	0.784
5	0.692	-.415	0.154	0.055	0.780	0.166	-.158	-.129	0.678
6	0.702	-.479	0.126	0.007	0.771	0.175	-.196	-.171	0.693
8	0.710	0.440	-.005	-.126	0.200	0.796	-.168	0.105	0.713
9	0.477	0.433	0.053	-.095	0.071	0.639	-.036	0.110	0.427
10	0.659	0.301	0.112	-.156	0.272	0.695	-.075	-.004	0.562
12	0.412	-.005	0.095	-.048	0.303	0.290	-.054	-.047	0.181
14	-.023	-.164	0.121	-.383	-.003	0.014	0.038	-.432	0.189
15	0.003	-.101	0.096	-.248	0.033	0.047	0.026	-.280	0.082
16	0.063	-.018	-.097	-.046	0.008	0.030	-.120	-.027	0.016
17	0.562	0.072	-.055	-.113	0.294	0.440	-.235	-.035	0.336
18	-.117	-.409	0.076	-.654	-.028	-.129	-.056	-.771	0.615
19	-.123	-.390	0.174	-.627	-.004	-.116	0.044	-.759	0.591
20	0.383	-.195	-.642	0.176	0.224	-.029	-.729	0.217	0.629
22	0.537	-.209	0.155	0.218	0.607	0.153	-.045	0.096	0.403
24	0.641	-.249	-.033	0.079	0.598	0.213	-.278	-.002	0.480
26	0.352	-.136	-.706	-.175	0.038	0.097	-.811	-.057	0.672
27	-.159	0.031	-.002	-.058	-.146	-.063	0.048	-.044	0.029
28	0.013	0.076	0.010	0.121	0.007	0.022	0.035	0.137	0.021
29	0.808	0.487	0.091	-.223	0.242	0.935	-.116	0.025	0.948
30	0.756	0.484	0.104	-.190	0.222	0.891	-.083	0.049	0.853
Sum of squared factor loadings:					3.895	3.718	2.184	1.595	
Variance accounted by factors:					0.169	0.162	0.095	0.069	

A-Communality calculated in terms of sum of squared factor loadings.

Variable code	Variable	Factor loading		Percentage contribution* of the factor to the communality of variable	Factor
8	Total number of flowers produced	0.796	....	88.87	II
9	Duration of flowering	0.639	....	95.62	II
10	Number of mature pods per plant	0.695	....	85.95	II
29	Pod yield per plant	0.935	....	92.22	II
30	Kernel yield per plant	0.891	....	93.06	II
3	Number of basal primary branches	0.843	....	94.63	I
4	Total number of branches per plant	0.873	....	97.21	I
5	Total number of leaves at harvest	0.780	....	89.73	I
6	Leaf area at harvest	0.771	....	85.78	I
22	Number of branches on 50th day	0.607	....	91.43	I
24	Leaf area on 50th day	0.598	....	74.50	I
2	Length of top	-.843	....	94.62	III
20	Plant height on 50th day	-.729	....	84.49	III
26	Height of main shoot at harvest	-.811	....	97.87	III
18	Number of days to fity percentage flowering.	-.771	....	96.66	IV
19	Duration ~~of flowering~~ to maturity	-.759	....	97.48	IV

* Obtained by the formula "(squared factor loading)/communality"

Fig. 4. Arrow diagram showing the importance of characters on factars : Data B.

Table 23. Principal factor solution of the factor loadings, after 60 iterations, of the environment correlation matrix of order 15 of data B.

Variable code	Factor loadings 1	2	3	Rotated loadings 1	2	3	A	B
4	0.533	-.167	-.362	0.277	-.044	-.604	0.444	0.562
6	0.548	-.320	-.425	0.268	-.186	-.691	0.583	0.538
8	0.816	0.028	0.218	0.805	0.128	-.222	0.714	0.668
9	0.600	0.830	0.313	0.667	0.139	-.023	0.465	0.447
10	0.705	-.108	0.233	0.729	-.023	-.176	0.563	0.534
12	0.413	-.115	-.055	0.330	-.044	-.275	0.187	0.293
14	-.025	-.274	0.007	0.002	-.273	-.028	0.076	0.166
17	0.566	-.107	-.068	0.454	-.011	-.361	0.337	0.392
18	-.246	-.803	0.115	-.089	-.838	0.085	0.718	0.628
19	-.253	-.820	0.152	-.074	-.861	0.117	0.760	0.627
20	0.282	0.045	-.440	0.006	0.134	-.507	0.275	0.442
26	0.288	-.105	-.339	0.076	-.023	-.450	0.209	0.435
27	-.143	-.019	0.142	-.046	-.056	0.189	0.020	0.106
28	0.029	0.139	-.008	0.010	0.141	0.002	0.020	0.106
30	0.828	-.031	0.322	0.874	0.061	-.151	0.791	0.692
Sum of squared loadings:				2.873	1.639	1.670		
Var. accounted by factors:				0.192	0.109	0.111		

A- Communality calculated in terms of sum of squared factor loadings

B -Initial estimates of communality(squared multiple correlation coefficient)

Table 24. Principal factor solution of factor loadings, after 50 iterations, of the genotypic correlation matrix of order 15 of data B.

Variable code	Factor loadings 1	2	3	Rotated loadings 1	2	3	*A	B
4	0.699	-.147	0.342	0.630	-.476	0.069	0.628	0.610
6	0.774	0.125	-.051	0.773	-.059	-.131	0.616	0.746
8	-.041	0.106	0.091	-.003	0.043	0.139	0.021	0.221
9	-.068	0.352	0.095	0.048	0.244	0.275	0.138	0.325
10	0.464	-.631	-.254	0.237	-.473	-.631	0.677	0.577
12	0.582	0.171	-.038	0.605	0.017	-.058	0.369	0.483
14	0.079	0.811	0.063	0.329	0.590	0.459	0.667	0.577
17	0.768	0.389	0.141	0.859	0.045	0.168	0.761	0.746
18	0.537	-.533	0.247	0.352	-.691	-.178	0.634	0.554
19	0.745	0.040	0.001	0.721	-.148	-.125	0.557	0.569
20	-.093	0.678	-.478	0.107	0.827	-.026	0.697	0.535
26	0.492	0.439	-.318	0.594	0.407	-.132	0.536	0.569
27	-.363	-.355	-.420	-.468	0.039	-.462	0.434	0.463
28	0.304	-.251	0.007	0.211	-.277	-.185	0.155	0.356
30	0.377	-.225	-.899	0.260	0.230	-.939	1.002	0.559
Sum of squared loadings:				3.596	2.347	1.951		
Var. accounted by factors:				0.240	0.157	0.130		

A - Communality calculated in terms of sum of squared factor loadings

B- Initial estimates of communality (largest correlation coefficient) got a value for the communality, little more than unity (1.001), which is illogical.

The factor loadings after 51 iterations are given in Table 24. Without factor rotation characters of importance were found to identify in all factors. The dominant characters of factors were:

Factor I :- Leaf area at harvest (6)
Haulm yield (17)
Duration to maturity (19)
Number of branches per plant (4)
Number of immature pods (12)
Days to 50 percentage flowering (18)

Factor II :- Hundred pod weight (24)
Plant height on 50th day (20)
Number of mature pods per plant (10)

Factor III :- Kernel yield per plant (30).

4.2.6 Discriminant analysis.

The genetic distance between the population were calculated based on the 15 variables and are presented in appendix 12. The latent roots of the between sum of product matrix of transformed variables (Y-variables) are given in Table 25a. The first two roots accounted for 94.85 per cent of variance. The first three canonical vectors are provided in Table 25b. The first row of the inverse of transposed V-matrix, the discriminant function coefficients of X-variables, and the standard weights are given in Table 25c.

The characters leaf area at harvest (6), haulm yield (17), plant height on 50th day (20) were found contributing maximum towards divergence. The standardised weights these characters were also higher and found to keep the same order in magnitude. But the fourth important character according to canonical coefficients is different from that according to standard weight. A discriminant function with the thirty variables showed that the characters hundred pod weight (14), leaf area on 50th day (26), leaf area at harvest (6), duration of flowering (9), and haulm yield (17) are the characters contributing maximum towards divergence.

The genotypes were pltted according to their mean canonical values (Table 26) obtained for the first two canonical vectors. The clusters were formed quite intuitively (fig. 5)

With the genetic distances obtained (appendix 12), the genotypes were grouped by means of weighted average link method of heirarchical clustering, and the dendrogram was drawn (fig. 6).

Table 25a. The eigen roots of between sum of product matrix of transformed variables(Y) of data B.

Sl. No.	Latent Roots	Contribution to variance
1	2615.42	91.05
2	108.49	3.78
3	46.42	1.62
4	37.71	1.31
5	24.24	0.84
6	15.06	0.52
7	7.65	0.27
8	5.66	0.20
9	3.25	0.11
10	2.31	0.08
11	1.71	0.06
12	1.66	0.06
13	1.24	0.03
14	0.97	0.03
15	0.80	0.03

Table 25b. Latent vectors corresponding to the first three latent roots of Table 25a.

Variable code	Latent vectors 1	2	3
4	-.000	0.047	0.035
6	-.002	0.004	0.067
8	0.005	-.064	-.038
9	-.038	-.028	0.518
10	0.024	0.092	-.078
12	-.008	0.074	-.006
14	-.942	0.024	0.024
17	0.019	0.020	0.054
18	0.198	0.058	0.115
19	0.022	0.044	0.341
20	0.183	-.016	0.025
26	0.049	-.030	0.090
27	0.005	-.046	-.742
28	0.006	0.936	0.142
30	-.144	0.130	-.076

Table 25c. Coefficients of discriminant function.

First row of Inv(V')	Variable code	Canonical vector corresponding to original (x) variables	Standard weights
1.397	4	-.0003	-.0004
327.189	6	0.7966	-400.1233
4.870	8	-.0244	0.4168
0.449	9	-.0169	-.0525
1.099	10	-.0259	0.0898
0.537	12	-.0043	-.0055
-.003	14	-.0027	0.0023
5.191	17	0.6197	8.1826
-.093	18	-.0184	-.0199
-.203	19	-.0044	-.0138
1.260	20	-.2306	-1.5540
0.949	26	0.0463	0.4733
-.132	27	-.0007	-.0009
-.020	28	-.0001	-.0001
0.695	30	-.1002	-.2297

Table 26. Varietal means according to the first two canonical variates : data B.

Code Number	Canonical axis 1	Canonical axis 2	Code Number	Canonical axis 1	Canonical axis 2
1	- 85.25	86.67	32	-112.21	87.06
2	-110.38	89.42	33	-118.40	94.10
3	-133.20	105.47	34	-120.96	107.58
4	-126.44	98.82	35	-155.41	107.58
5	-112.77	98.05	36	- 93.74	87.34
6	-176.05	90.70	37	-196.43	96.68
7	-202.22	87.01	38	-153.84	85.16
8	-170.30	95.65	39	-113.55	83.35
9	-176.19	87.02	40	-120.41	93.10
10	- 85.82	91.33	41	-144.62	95.87
11	-112.77	97.57	42	-79.64	92.26
12	-124.02	105.91	43	-143.69	87.27
13	-137.17	86.70	44	-162.16	82.68
14	-103.36	100.75	45	-107.51	88.68
15	- 71.48	99.17	46	-186.41	92.35
16	- 90.51	94.00	47	-131.61	91.53
17	-162.70	85.47	48	-109.11	90.97
18	-111.41	85.35	49	-152.75	100.08
19	-106.98	88.14	50	-113.79	91.53
20	-141.93	93.10	51	-123.23	88.27
21	-125.92	94.63	52	-119.07	101.83
22	-141.74	102.29	53	-112.13	88.62
23	- 98.35	89.45	54	-101.48	91.57
24	-122.42	100.19	55	-81.19	91.95
25	- 89.60	81.99	56	-179.34	95.49
26	- 97.47	94.55	57	-111.31	98.88
27	-104.49	86.88	58	-125.59	93.35
28	-143.27	95.13	59	-112.30	98.89
29	-106.30	98.81	60	- 93.64	95.65
30	-134.98	92.15	61	-101.92	101.36
31	-128.94	91.42	62	-118.15	95.26

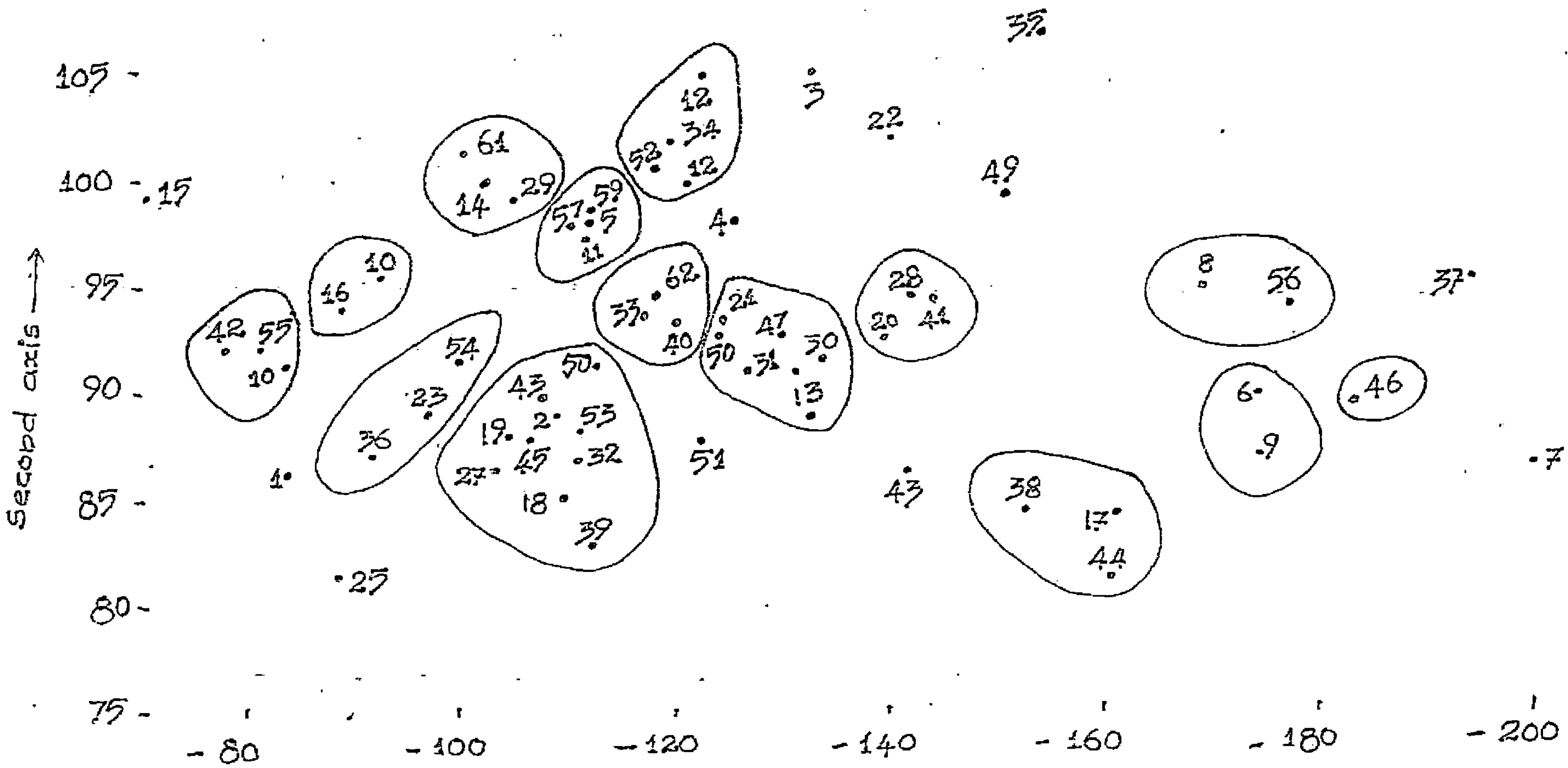

Fig: 5 Scatter diagram showing the positions of 62 varieties of Groundnut on the basis of first two canonical variates - data B

Discussion

D I S C U S S I O N

Majority of the data arising from the various branches of science are multivariate in nature and methods of analysing such data constitute an increasingly important area of Statistics. A number of procedures are available to analyse the data invloving several varieties assigning equal status to each and to quantify the results the way the biologists need. The choice of an appropriate method depends on the type of the problem and the objectives envisaged. The immense computations involved in these analyses are taken over by the computers and this has revolutionised the subject, leading to a vast expansion in the number of analyses being undertaken.

A major problem that often arises in multivariate studies is the choice of appropriate variables that are to be included in the variable dimension. It is a well known fact that the simultaneous study of a number of variables in general, is superior to several univariate analyses. But the inclusion of unimportant variables in the dimension will no doubt lead to incorrect interpretations of the data. A multivariate data with 30 characters on 62 bunch type varieties of groundnut are utilised for the study. The analysis of plot means revealed high significant differences among the genotypes for each character, excluding the character, plant spread on 50th dat. This character si is ~~not~~ found not satisfying the additivity assumption of ANOVA, under both the environments, when examined with Tukey's test of addivity. The analysis of dispersion using Wilk's lambda criterion revealed highly significant differences among the varieties for the aggregate of 30 characters. However, before carrying out interdependent analyses, the variables which were linearly dependent, and the ratiorof variables that had already been included were discarded. As such seven variables were first discarded including the variable plant spread on 50th day, leaving 23 variables in the dimension.

The genotypic correlation matrix of order 23 is found to be non-negative definite, as some of its eigen values are negative. But a correlation matrix should always be positive-definite, as it stems from the fact that the covariance matrix is always positive-definite. When the covariance matrices were estimated by methods other than product moments, it may sometime lack the non-negative definite property (K (Kendall et al., 1983). Further they warned against the attempts of component and factor analysis with such matrices. In order to obtain a genotypic correlation matrix in positive definite form the variables are discarded quite intuitively. By eliminating the rows and columns of the genotypic correlation matrix having values more thant or equal to unity, and testing for the non-negative definite form, eight more variables were discarded, resulting in a matrix of order 15.

Three factors and four factors are extracted from the environment correlation matrix of order 23. The principal factor solution of the genotypic correlation matrix is compared with the environment correlation matrix of order 15.

The yield and reproductive characters viz., pod yield per plant, kernel yield per plant, number of flowers produced and duration flowering are described the first factor extracted from the environment correlation matrix of data A (Table 9). The second factor is mainly associated with vegetative characters like number of branches on 50th day, number of leaves on 50th day, leaf area on 50th day, number of basal primary branches, number of branches per plant, number of leaves at harvest, and leaf area at harvest. The third factor is characterised by number of days to 50 percentage flowering and duration to maturity, which are assoċated with the growth of the plants. When four factors are extracted from the environment correlation matrix of data A, the first three factors showed the same pattern of factor loadings as that of three factor solution. Further, none of the characters showed significant loading on the fourth factor. Thus it can be postulated that, only three factors are working in uplands.

The first factor in rice fallows dominated for vegetative characters and the second factor for yield and reproductive characters. The characters related to height of the plant viz., plant height on 50th day, length of top at harvest, height of main shoot at harvest are found dominating in the third factor. The factor associated with growth characters is found absent in the three factor solution. But the four factor sdlution bringforth this factor. Further, when four factors are tried, the communality of the growth measuring variables-daysto 50 percentage flowering and duration to maturity-increased respectively from 0.77 to 0.615 and 0.087 to 0.591. Thus it is hypothicated that four factors are working in rice fallows.

The factors are named conveniently as 'vegetative', 'reproductive', and 'growth' factors in accordance to the nature of dominant characters in each factor. The additional factor found in rice fallows is the height factor. This result is in contradiction with the results obtained for other crops, where the characters related to the height of the plant are clustered along with the vegetative characters (Murthy and Arunachalam, 1967a; Singh, 1973).

The important characters of each factor are isolated without factor rotation in data A (uplands), while with rotation in data B (rice fallows). Majority of the characters in data B have larger communality than that of data A.

Different clusters of variables are obtained from principal factor analysis of the genotypic correlation matrix of order 15 of data A and data B. The clusters of variables are not leading to valid conclusions regarding the 'underlying' factors of divergence. As the clusters of characters are dissimilar in uplands and rice fallows, it may be concluded that the estimated values of genotypic corrdlations are subjected to large gvariations in these two environments. However, this is against the expecations that the genotypic correlation matrices will have similarity, as the same genotypes are observed under both the environments.

A comparison of factor loadings obtained for genotypic correlation matrix and environment correlation matrix showed large differences. Many workers have reported similar clusters of variables with environment and genotypic correlations (Murthy et al., 1967; Sundaram et al., 1980). Results of factor analysis can be interpreted as the impact of selection. According to Murthy et al. (1970), genotypic correlation matrix will reflect the impact of selection while, the environment correlation matrix will not undergg changes under selection. Thus the differences among the factor loadings can be attributed to the changes in genetic association of the characters. The differences in the factor solutions of genotypic and environment correlation matrices observed in present study leads to the conclustion that the selection of of characters has substantial impact on factor loadings. However, the results of factor analysis with genotypic correlation leave behind certain doubts about its validity. The genotypic effects are fixed and correlation between genotype and environment is absent in the field (Kempthorne, 1957). But there may be genotype-environment interaction, which is conveniently assumed absent for the estimation of variance components. As the groundnut varietes are of bunchtype, a pa particular habitat group, the genotypic effects need not follow exact normality, and they can't be considered as a random sample from the population. Selection and breeding are found influencing the distribution of genotypic effects (Murthy and Arunachalam, 1967). Considering all these, the genotypic covariance estimates may not be a proper estimate of the population parameters. So that, it may not follow Wishart's distribution. However, environment effects are random and follow normal distribution. In the case of principal component analysis and factor analysis, the error (environment) dispersion is treated as an estimate of the dispersion of the population and it can be considered as the appropriate estimate of the covariance matrix for structural studies.

Though, the factor analysis is a powerful tool for exploratory analysis, it suffers many drawbacks related with distribution, number of factors, method of estimation etc.. Once the distributional problems are answered, the next question is on the fixation of the number of factors needed to achieve a certain degree of explanation of the biological nature of the data. No definite answer exists for this, the decision is quite arbitrary, and a compromise must be established.

Such an arbitrariness prevailse when one encounters with the question of the magnitude of factor loadings that imply biological significance. Ideally, the major variables in a factor would show high loedings (0.80 to 0.99) and all other variables; low values (0 to 0.20); Danis and Adams (1978). But in the present study, some of the variables have loadings between the range 0.50 to 0.79. Such loadings may also be considered as significant, if these variable have negligible loadings in other factors.

It is a common practice to describe the results of factor analysis along with percent total variation explained by each factor. The earlier workers in this field reported that they had obtained few factors capable of explaining more than 90 per cent of the total variability. Often these kind of figures were in use for interpreting the results. Murthy and Arunachalam (1967b) reported 100 percent, 92 percnet and 70 percent explanation of variance in a factor analysis (cnetroid method) study with environment and genotypic correlations in sorghum. Similar results were reported by Murthy et al (1970) and Sundaram et al. (1980). This however, seems to be unrealistic because, the sum of final values of communality expressed in terms of initial values was taken as the percentage variance explained by the common factors in these studies. The proportion of variance explained by the factors is the sum of final values of communality in terms of total variance. This is equal to the ratio of the sum of eigen roots corresponding to the factors obtained in the final iteration to the total variance. Recently, Sawant et al., (1984) reported that, two factors identified for the crop triticale accounted for 46 per cent of the total variability. Kukadia et al. (1984) reported that two factors identified for sorghum ~~accounted~~ accounted for 59 per cent of variability. The three factors identified for soyabeen found to be accounted for 51.8 per cent of variance (Bartual et al., 1985). In the present study on groundnut, similar results were obtained. The three factors identified in uplands 39 per cent of the total variation (Table 9). The four factors of rice fallows explains 49.5 per cent of the total variation (Table 22).

An important feature of factor analysis observed in this study is that the order of importance of facdtrs is influenced by the number and nature of the variables considered. For instance, the vegetative factor is the most important one in 23 variable -case of data B, but it becomes third in rank with the 15 variable-case, where some of the vegetative characters are not included. Thus the ranking of the factors according to the percentage contribution of the total varainces may sometimes lead to wrong interpretation especially, in biological situations, where the exact nature of the variables will often be not clear. Thus it is safe to consider all factors equally important, unless the experimenter has the ability to take subjective decisions on the importance of factors.

The covariance structure revealed through factor analysis has much practical utility. The number and nature of causative factors influencing the diversity of a population particularly, on which more intensive work can be concentrated may be a field of greater interest. Factor analysis provides more information than correlated variables with a few number of factors. Such information about the dependent structure of different characters is very useful in plant breeding. As Murthy *et al.* (1970) pointed out, factor analysis procedures are more useful than correlation search methods in biological evolution, since the experimenter is unlikely to have *a priori* knowledge of causative influences. This method will help to provide a meaningful explanation of the major forces responsible for inter- and intra-specific differentiation in plants.

The usefulness of factor analysis in clustering the correlated characters is well known. If these characters have positive genotypic correlation, then one can expect a simultaneous improvement in all these characters by improving any one of the character in this clusters. In the present study the characters grouped into factors are found to have positive genotypic correlation except for the reproductive factor.

The characters in a given factor with which high factor loadings and low communality is amenable to change very easily due to selection as compared to one with high factor loading and high communality (Sawanth *et al.*, 1982). The percentage contribution of a factor to the communality of the variables may help to identify such variables in a factor. The logic is that the variable with high loading in one factor and low communality will have maximum contribution from that factor towards its communality. The characters which are more amenable to change due to selection in uplands are total number of flowers produced in reproductive factor, leaf area at harvest in vegetative factor, and number of days to 50 percentage flowering in growth factor. The characters identified for rice fallows are number of branches per plant in vegetative factor, duration of flowering in reproductive factor, height of main shoot at harvest in height factor and duration to maturity in growth factor.

In many cases the component loadings or component correlations are interpreted as factor loadings. Often, this kind of component analysis is termed as factor analysis through principal component method (Tikka and Asawa, 1978; Sawanth *et al.*, 1982; Kukadia *et al.*, 1984). The major axes of variation existing in the data may be interpreted satisfactorily by looking at these loadings. Component loadings after a varimax rotation yielded the same pattern of results as that with principal factor analysis in all the cases considered in this study. But the communality obtained through principal component analysis is found to be different from that through principal factor analysis. Bartual *et al.* (1985) reported similar results, where the maximum likelihood solution of factor analysis was compared with the results of principal components.

Though factor analysis and principal component analysis are of with some-what similar objectives, they are substantially different. The latter doesnot rely on any statistical model and assumptions implied in factor analysis particularly to the covariance structure. Factor analysis helps to ascertain whether the model set up for the system fits the data or not, while principal component analysis examine a system to see what sort of structure it may have (Kendall *et al.*, 1983). In practical sense, principal component analysis aims at explaining the variance of the individual measurements, on the other hand, factor analysis explains the inter-correlations among the measurements. The major utility of principal component analysis is its utility to have a parsemoneous summarisation of the data. Reports areoften found in literature which points out that the results obtained form factor analysis through the method of principal components, and through any other methods are in agreement. This can be expected only when communalities are nearly equal for all the variables (Rao, 1955). But even with large differences among communalities, similar pattern of results are observed in this study.

This supports the remark by Chatfield and Collines (1980) that no general rule can be given for a reasonable agreement of the results with the two procedures. Principal factor analysis carries with it the flavor of principal component analysis is intended to explain the variation in the standardised scores and as such not so powerful in explaining the correlations among characters compared to canaonical facbor analysis (Rao, 1955).

The genetic distance among the genotypes with respect to the 15 characters are not found in agreement under both environments. This may be explained on the ground that certain genotypesperformed better in one environment than the other. In statistical terms, there may exist certain genotype-environment interaction. This togather with the sampling variation of the statistic cause is the cause of variations in genetic distance. Because of such a dissimilarity in genetic distance, the clusters formed for the two environments are not found in agreement.

The variables contributing maximum towards genetic divergence are observed to be the same in both environments in the 15 variable-study. They are leaf area at harvest, haulm yield, and plant height on 50th day. But this order of improtance gets disturbed when all the variables are considered. For instance, the character hundred pod weight gets prior importance when all characters are considered, while it has only little importance with the 15 variable - study. This calls for the need for an appropriate variable selection procedure in discriminant analysis. The stepwise discriminant analysis may yield better results (Stepwise discriminant analysis; Jennrich, 1977).

In discriminant analysis, prior importance is given to those characters which are most effective in differentiating the genotypes, in the sense that these characters maximise the between variation, making the within variation minimum. The inter-relationships of the characters are not considered in this analysis, which limits its usefulness in plant breeding programmes, where the observed characters are some convenient measurable components of yield potentiality and other such economic traits.

The positions of varieties obtained from the canonical analysis diagram almost agree to the nearness of varieties exhibhited by the dendrogram. The contiguous varieties are grouped into clusters.quite intuitively. However, no attempt was made to optimise the number of clusters through dendrogram. The clusters obtained by the sudden clumping of spliting levels and the one obtained by average coefficient of variations are almost similar.

Summary

S U M M A R Y

The utility of multivariate analysis in measuring the degree of divergence between biological population and in assessing the relatige contribution of various characters towards total divergence has been observed by several workers. A knowlege of the relationship between yield and its component characters will be of much use in plant breeding programmes. In recent years plant breeders have realized that selection depending upon the yield alone need not be the most efficient means to produce lines with improved performance. So, identification of characters towards genetic differentiation is of utmost concern to a plant breeder.

Discriminant analysis, principal component analysis and factor analysis are multivariate methods which opened new vistas in the field of applied research, especially in biological and social sciences. Discriminant analysis is a method to obtain information on the diversity in a population, principal component analysis is designed to account for the total variation optimally with the least number of principal components, while factor analysis is used to explain the inter-relationships among the variables optimally in terms of a few common factors as possible.

Though, the above multivariate techniques have specified objectives, their appropriate use in the field of applied research turns difficult for several reasons, and hence the comparison of the methods will be of interest. These methods were tried with a data generated from a plant breeding trial on 62 bunch type varieties of groundnut conducted in two environments viz., uplands and rice fallows.

Analysis of dispersion using Wilk's lambda criterion revealed significant differences among the varieties for the aggregate of 30 characters under study. All these characters, except plant spread on 50th day, showed significant varietal differences. This character is not found to satisfy the additivity assumption of ANOVA. However, those variables which are linearly dependent with the other variables, and the ratio of variables that have already been considered were discarded from the variable dimension, leaving 23 variables. In order to obtain a genotypic correlation matrix with non-negative definite form, eight more variables were discarded.

Principal factor analysis was performed to resolve the variables into a lesser number of factors. The analysis revealed that three factors are mainly responsible for the genetic differentiation in uplands. These factors were named as vegetative, reproductive and growth factors in accordance to the nature of the dominant characters in each factor. The same factors were found working in rice fallows. In addition to these, another factor related to the height of the plant was also found working there. The characters which are more amenable to change due to selection were found out for each factor under the two environments. Leaf area at harvest, total number of flowers produced and number of days to 50 percentage flowering are the characters which come under vegetative, reproductive and growth factors in uplands respectively. The characters obtained for rice fallows were number of branches per plant, duration of flowering and duration to maturity. The character identified for selection in the height factor in rice fallows was height of main shoot at harvest. Pod yield per plant was also found contributing to the reproductive factor in both the environments. The order of importance of factors were found varying according to the number and nature of variables considered for the analysis.

The results obtained when principal component analysis employed to estimate factor loadings were observed to be almost of the same pattern with that of principal factor analysis. This reveals that inspite of shortcomings of each method, conclusions obtained from their application were valid in the context of this study. However, a generalization is hardly possible in this regard.

The factor loadings obtained with genotypic and environment correlations were markedly different. This is due to the fact that selection had already been operated in the population. Factor analysis with genotypic correlation matrix gave different loading pattern for variables under the two environments, while with environment correlation matrix the same characters were clustered into factors. So, the environment correlation matrix is found to be the appropriate estimate of correlation matrix for interdependent analytical studies.

A comparison of the results of factor analsysis and discriminant analysis shown the reliability of factor analysis over discriminant analysis in isolating the characters towards genetic differentiation.

Genetic distance among the varieties based on 15 characters were computed using Mahalanobis D^2 and the varieties were arranged according to the magnitude of divergence. The varieties were plotted against the two canonical axis and the contiguous points were grouped together intuitively. A heirarchical classification with weighted average link method was tried and dendrograms were drawn. Good similarity was observed for clusters of genotypes by these two methods. The genetic distance among varieties were different in the two environments. This may be due to the presence of genotype-environment interaction.

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Appendix

APPENDIX - BETWEEN CORRELATION MATRIX : DATA A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		-.163	0.031	-.030	0.041	0.103	0.109	0.062	-.006	0.748	0.622	0.444	0.320	-.223	0.102	0.120	0.152
2	-.163		-.065	-.078	0.067	0.183	0.182	-.244	-.332	-.257	-.009	0.100	-.295	0.327	0.044	-.261	0.273
3	0.031	-.065		0.901	0.625	-.008	0.007	0.199	-.033	-.112	-.159	-.030	-.118	0.077	0.347	0.137	0.646
4	-.030	-.078	0.901		0.592	-.024	-.018	0.357	0.058	-.156	-.311	0.013	-.191	0.100	0.298	0.100	0.725
5	0.041	0.067	0.625	0.592		0.428	0.441	0.222	0.045	-.140	-.178	-.196	0.087	0.121	0.231	0.060	0.547
6	0.103	0.183	-.008	-.024	0.428		0.995	0.223	-.055	0.103	-.032	-.174	0.276	-.031	-.010	-.013	0.070
7	0.109	0.182	0.007	-.018	0.441	0.995		0.236	-.042	0.112	-.032	-.175	0.285	-.029	-.013	-.033	0.082
8	0.062	-.244	0.199	0.357	0.222	0.223	0.236		0.472	0.172	-.499	-.075	0.202	-.248	-.124	-.055	0.237
9	-.006	-.332	-.033	0.058	0.045	-.055	-.042	0.472		0.047	-.344	-.237	0.179	-.027	-.068	0.054	-.029
10	0.748	-.257	-.112	-.156	-.140	0.103	0.112	0.172	0.047		0.714	0.433	0.474	-.580	-.339	0.200	-.042
11	0.622	-.009	-.159	-.311	-.178	-.032	-.032	-.499	-.344	0.714		0.438	0.253	-.333	-.175	0.187	-.145
12	0.444	0.100	-.030	0.013	-.196	-.174	-.175	-.075	-.237	0.433	0.438		-.482	-.193	-.174	0.008	0.134
13	0.320	-.295	-.118	-.191	0.087	0.276	0.285	0.202	0.179	0.474	0.253	-.482		-.312	-.079	0.106	-.146
14	-.223	0.327	0.077	0.100	0.121	-.031	-.029	-.248	-.027	-.580	-.333	-.193	-.312		0.668	-.331	0.155
15	0.102	0.044	0.347	0.298	0.231	-.010	-.013	-.124	-.068	-.339	-.175	-.174	-.079	0.668		0.009	0.299
16	0.120	-.261	0.137	0.100	0.060	-.013	-.033	-.055	0.054	0.200	0.187	0.008	0.106	-.331	0.009		0.060
17	0.152	0.273	0.646	0.725	0.547	0.070	0.082	0.237	-.029	-.042	-.145	0.134	-.146	0.155	0.299	0.060	
18	0.074	-.156	0.356	0.434	0.257	-.167	-.151	0.240	0.133	0.149	-.027	0.067	0.003	-.220	-.086	0.196	0.394
19	0.225	-.119	0.388	0.479	0.229	-.120	-.117	0.139	0.016	0.069	-.016	0.044	0.070	0.047	0.231	0.048	0.434
20	-.221	0.499	-.242	-.284	-.048	0.163	0.160	-.261	-.156	-.381	-.107	-.272	-.065	0.511	0.188	-.328	-.134
21	-.114	0.477	0.011	-.050	0.122	0.246	0.235	-.052	-.233	-.223	-.131	-.230	0.020	0.220	0.099	-.214	0.148
22	0.079	-.079	0.862	0.931	0.660	0.086	0.089	0.395	0.064	-.044	-.243	-.035	-.034	0.013	0.234	0.119	0.703
23	0.047	-.003	0.785	0.838	0.710	0.167	0.169	0.327	0.075	-.112	-.251	-.118	-.003	0.151	0.233	0.045	0.668
24	0.113	0.093	0.173	0.172	0.383	0.844	0.836	0.367	0.007	0.121	-.104	-.212	0.310	-.045	-.006	-.027	0.195
25	0.109	0.131	0.168	0.168	0.408	0.882	0.875	0.354	-.011	0.110	-.109	-.192	0.277	-.033	0.001	-.002	0.182
26	-.174	0.973	0.025	0.014	0.145	0.162	0.162	-.180	-.275	-.292	-.075	0.032	-.267	0.356	0.090	-.230	0.338
27	0.332	0.092	0.008	-.056	-.023	0.016	0.020	0.002	-.046	0.116	0.043	0.281	-.171	-.031	-.028	0.046	0.051
28	-.297	0.014	0.139	0.118	0.038	-.200	-.207	-.154	-.082	-.192	-.081	0.064	-.248	0.005	0.037	0.204	-.025
29	0.937	-.205	0.037	-.006	0.068	0.130	0.134	0.085	0.016	0.750	0.629	0.350	0.412	-.211	0.130	0.097	0.151
30	0.936	-.203	0.070	0.002	0.069	0.092	0.090	0.030	0.025	0.724	0.615	0.424	0.295	-.282	0.096	0.442	0.162

	18	19	20	21	22	23	24	25	26	27	28	29	30	SD
1	0.074	0.225	-.221	-.114	0.079	0.047	0.113	0.109	-.174	0.332	-.297	0.937	0.936	7.7372
2	-.156	-.119	0.499	0.477	-.079	-.003	0.093	0.131	0.973	0.092	0.014	-.205	-.203	23.0112
3	0.356	0.388	-.242	0.011	0.862	0.785	0.173	0.168	0.025	0.008	0.139	0.037	0.070	1.9532
4	0.434	0.479	-.284	-.050	0.931	0.838	0.172	0.169	0.014	-.056	0.118	-.006	0.002	4.3851
5	0.257	0.229	-.048	0.122	0.660	0.710	0.383	0.408	0.145	-.023	0.038	0.068	0.069	21.7063
6	-.167	-.120	0.163	0.246	0.086	0.167	0.844	0.882	0.162	0.016	-.200	0.130	0.092	%1261.1920
7	-.151	-.117	0.160	0.235	0.089	0.169	0.836	0.875	0.162	0.020	-.207	0.134	0.090	2.0883
8	0.240	0.139	-.261	-.052	0.395	0.327	0.367	0.354	-.180	0.002	-.154	0.085	0.030	42.6183
9	0.133	0.016	-.156	-.233	0.064	0.075	0.007	-.011	-.275	-.046	-.082	0.016	0.025	17.0074
10	0.149	0.069	-.381	-.223	-.044	-.112	0.121	0.110	-.292	0.116	-.192	0.750	0.724	9.3530
11	-.027	-.016	-.107	-.131	-.243	-.251	-.104	-.109	-.075	0.043	-.081	0.629	0.615	9.4221
12	0.067	0.044	-.272	-.230	-.035	-.118	-.212	-.192	0.032	0.281	0.064	0.350	0.424	1.6336
13	0.003	0.070	-.065	0.020	-.034	-.003	0.310	0.277	-.267	-.171	-.248	0.412	0.295	3.4472
14	-.220	0.047	0.511	0.220	0.013	0.151	-.045	-.033	0.356	-.031	0.005	-.211	-.282	30.4528
15	-.086	0.231	0.188	0.099	0.234	0.233	-.006	0.001	0.090	-.028	0.037	0.130	0.096	9.1092
16	0.196	0.048	-.328	-.214	0.119	0.045	-.027	-.002	-.230	0.046	0.204	0.097	0.442	11.9523
17	0.394	0.484	-.134	0.148	0.703	0.668	0.195	0.182	0.338	0.051	-.025	0.151	0.162	46.2435
18		0.483	-.595	-.326	0.387	0.273	-.166	-.135	-.089	-.104	-.023	0.110	0.108	3.2448
19	0.483		-.387	-.136	0.437	0.407	-.023	-.039	-.069	-.123	-.070	0.277	0.210	10.3783
20	-.595	-.387		0.514	-.260	-.113	0.111	0.124	0.501	0.003	-.044	-.222	-.292	11.8443
21	-.326	-.136	0.514		0.002	0.185	0.343	0.344	0.508	0.021	-.087	-.120	-.183	6.8289
22	0.387	0.437	-.260	0.002		0.914	0.324	0.318	0.018	-.004	0.097	0.097	0.104	3.0293
23	0.273	0.407	-.113	0.185	0.914		0.449	0.442	0.095	0.036	0.012	0.051	0.058	16.8604
24	-.166	-.023	0.111	0.343	0.324	0.449		0.981	0.098	0.064	-.178	0.121	0.089	729.5333
25	-.135	-.039	0.124	0.344	0.318	0.442	0.981		0.136	0.091	-.168	0.107	0.093	1.1896
26	-.089	-.069	0.501	0.508	0.018	0.095	0.098	0.136		0.069	0.004	-.205	-.202	23.5342
27	-.104	-.123	0.003	0.021	-.004	0.036	0.064	0.091	0.069		-.110	-.008	0.334	9.3808
28	-.023	-.070	-.044	-.087	0.097	0.012	-.178	-.168	0.004	-.110		-.282	-.158	5.8328
29	0.110	0.277	-.222	-.120	0.097	0.051	0.121	0.107	-.205	-.008	-.282		0.865	11.7129
30	0.108	0.210	-.292	-.183	0.104	0.058	0.089	0.093	-.202	0.334	-.158	0.865		5.9277

APPENDIX - WITHIN CORRELATION MATRIX : DATA A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		0.164	0.244	0.178	0.149	0.071	0.087	0.694	0.566	0.742	0.496	0.443	0.025	0.069	0.100	0.122	0.309
2	0.164		-.111	0.034	0.031	0.039	0.038	0.218	0.200	0.146	-.076	0.213	-.060	-.111	0.089	0.044	0.153
3	0.244	-.111		0.681	0.403	0.380	0.406	0.152	0.077	0.212	0.278	0.106	0.127	0.071	0.197	-.074	0.386
4	0.178	0.034	0.681		0.312	0.442	0.415	0.128	0.106	0.162	0.117	0.134	0.049	0.096	0.072	-.088	0.261
5	0.149	0.031	0.403	0.312		0.810	0.795	0.118	0.106	0.220	0.166	0.163	0.086	0.056	0.039	0.156	0.156
6	0.071	0.039	0.380	0.442	0.810		0.961	0.069	0.129	0.139	0.113	0.057	0.129	0.073	-.009	0.185	0.128
7	0.087	0.038	0.406	0.415	0.795	0.961		0.086	0.130	0.177	0.157	0.111	0.094	0.119	-.003	0.226	0.145
8	0.694	0.218	0.152	0.128	0.118	0.069	0.086		0.820	0.733	0.175	0.362	0.139	-.028	-.050	0.070	0.187
9	0.566	0.200	0.077	0.106	0.106	0.129	0.130	0.820		0.594	0.152	0.337	0.130	-.038	-.022	0.015	0.166
10	0.742	0.146	0.212	0.162	0.220	0.139	0.177	0.733	0.594		0.531	0.440	0.109	0.020	0.146	0.093	0.312
11	0.496	-.076	0.278	0.117	0.166	0.113	0.157	0.175	0.152	0.531		0.333	0.070	0.116	0.281	0.008	0.214
12	0.443	0.213	0.106	0.134	0.163	0.057	0.111	0.362	0.337	0.440	0.333		-.652	-.039	0.101	-.018	0.258
13	0.025	-.060	0.127	0.049	0.086	0.129	0.094	0.139	0.130	0.109	0.070	-.652		0.047	0.024	0.056	-.063
14	0.069	-.111	0.071	0.096	0.056	0.073	0.119	-.028	-.038	0.020	0.116	-.039	0.047		0.034	0.135	-.023
15	0.100	0.089	0.197	0.072	0.039	-.009	-.003	-.050	-.022	0.146	0.281	0.101	0.024	0.034		0.130	0.136
16	0.122	0.044	-.074	-.088	0.156	0.185	0.226	0.070	0.015	0.093	0.008	-.018	0.056	0.135	0.130		-.097
17	0.309	0.153	0.386	0.261	0.156	0.128	0.145	0.187	0.166	0.312	0.214	0.258	-.063	-.023	0.136	-.097	
18	0.057	-.045	0.045	0.142	-.091	-.087	-.118	0.082	0.074	0.032	-.096	0.069	-.066	-.003	-.007	-.155	-.090
19	-.060	-.105	0.160	0.164	0.123	0.116	0.086	-.076	0.002	-.106	-.099	0.034	-.054	-.113	-.090	-.184	0.111
20	0.265	0.242	0.001	0.077	0.117	0.073	0.059	0.196	0.178	0.236	0.214	0.238	-.038	-.075	0.014	0.002	0.033
21	0.257	-.056	0.163	0.110	0.072	0.106	0.087	0.222	0.197	0.173	0.171	0.132	0.024	0.203	0.058	0.049	0.020
22	0.199	0.029	0.470	0.552	0.506	0.482	0.440	0.173	0.153	0.214	0.153	0.070	0.119	0.051	-.030	0.105	0.173
23	0.171	0.027	0.315	0.364	0.442	0.401	0.373	0.119	0.174	0.139	0.162	0.089	0.053	0.135	0.006	0.089	0.044
24	0.259	0.005	0.306	0.338	0.355	0.375	0.338	0.156	0.177	0.221	0.219	0.066	0.091	0.189	-.042	0.103	0.095
25	0.212	0.023	0.292	0.339	0.439	0.446	0.414	0.150	0.184	0.190	0.171	0.078	0.091	0.116	-.054	0.060	0.113
26	0.166	0.909	-.059	0.142	0.054	0.042	0.037	0.225	0.223	0.151	-.082	0.249	-.078	-.072	0.106	-.012	0.181
27	0.028	-.173	0.039	0.096	0.005	0.047	0.026	-.099	-.113	-.248	-.091	-.150	0.041	0.032	-.349	-.135	-.176
28	-.274	0.063	-.086	-.098	0.009	-.009	-.013	-.103	-.111	-.168	-.107	-.229	0.130	-.049	-.003	0.040	-.084
29	0.985	0.186	0.250	0.172	0.162	0.091	0.110	0.700	0.575	0.776	0.535	0.450	0.041	0.063	0.177	0.151	0.337
30	0.982	0.161	0.238	0.190	0.155	0.096	0.113	0.676	0.559	0.727	0.480	0.426	0.015	0.097	0.093	0.191	0.305

	18	19	20	21	22	23	24	25	26	27	28	29	30	SD
1	0.057	-.060	0.265	0.257	0.199	0.171	0.259	0.212	0.166	0.028	-.274	0.985	0.982	3.1009
2	-.045	-.105	0.242	-.056	0.029	0.027	0.005	0.023	0.909	-.173	0.063	0.186	0.161	9.5928
3	0.045	0.160	0.001	0.163	0.470	0.315	0.306	0.292	-.059	0.039	-.086	0.250	0.238	1.1234
4	0.142	0.164	0.077	0.110	0.552	0.364	0.338	0.339	0.142	0.096	-.098	0.172	0.190	1.6961
5	-.091	0.123	0.117	0.072	0.506	0.442	0.355	0.439	0.054	0.005	0.009	0.162	0.155	15.0775
6	-.087	0.116	0.073	0.106	0.482	0.401	0.375	0.446	0.042	0.047	-.009	0.091	0.096	417.5155
7	-.118	0.086	0.059	0.087	0.440	0.373	0.338	0.414	0.037	0.026	-.013	0.110	0.113	0.7017
8	0.082	-.076	0.196	0.222	0.173	0.119	0.156	0.150	0.225	-.099	-.103	0.700	0.676	15.0122
9	0.074	0.002	0.178	0.197	0.153	0.174	0.177	0.184	0.223	-.113	-.111	0.575	0.559	2.2547
10	0.032	-.106	0.236	0.173	0.214	0.139	0.221	0.190	0.151	-.248	-.168	0.776	0.727	3.9922
11	-.096	-.099	0.214	0.171	0.153	0.162	0.219	0.171	-.082	-.091	-.107	0.535	0.480	2.0416
12	0.069	0.034	0.238	0.132	0.070	0.059	0.066	0.078	0.249	-.150	-.229	0.450	0.426	0.9914
13	-.066	-.054	-.038	0.034	0.119	0.053	0.091	0.091	-.078	0.041	0.130	0.041	0.015	2.1556
14	-.003	-.113	-.075	0.203	0.051	0.135	0.189	0.116	-.072	0.032	-.049	0.063	0.097	1.0708
15	-.007	-.090	0.014	0.058	-.030	0.006	-.042	-.054	0.106	-.349	-.003	0.177	0.093	3.1519
16	-.155	-.184	0.002	0.049	0.105	0.089	0.103	0.060	-.012	-.135	0.040	0.151	0.191	0.7735
17	-.090	0.111	0.033	0.020	0.173	0.044	0.095	0.113	0.181	-.176	-.084	0.337	0.306	18.1533
18		0.552	-.079	0.119	0.063	0.043	0.072	0.001	-.036	-.012	-.069	0.045	0.044	1.8147
19	0.552		-.144	0.106	0.097	0.094	-.003	0.004	-.071	0.085	-.088	-.077	-.048	1.9758
20	-.079	-.144		0.217	0.235	0.178	0.107	0.110	0.217	-.067	0.004	0.255	0.256	6.1231
21	0.119	0.106	0.217		0.256	0.395	0.363	0.321	-.102	0.026	-.050	0.271	0.260	7.2037
22	0.063	0.097	0.235	0.256		0.717	0.635	0.673	0.085	-.001	-.082	0.204	0.225	1.2679
23	0.043	0.094	0.178	0.395	0.717		0.815	0.846	0.071	0.114	-.074	0.169	0.197	10.3285
24	0.072	-.003	0.107	0.363	0.635	0.815		0.921	0.026	0.163	-.060	0.249	0.288	366.5463
25	0.001	0.004	0.110	0.321	0.673	0.846	0.921		0.045	0.169	-.059	0.205	0.234	0.5807
26	-.036	-.071	0.217	-.102	0.085	0.071	0.026	0.045		-.145	0.047	0.175	0.158	10.4416
27	-.012	0.085	-.067	0.026	-.001	0.114	0.163	0.169	-.145		-.064	-.083	0.031	1.5876
28	-.069	-.088	0.004	-.050	-.082	-.074	-.060	-.059	0.047	-.064		-.249	-.310	3.4876
29	0.045	-.077	0.255	0.271	0.204	0.169	0.249	0.205	0.176	-.083	-.249		0.966	5.2803
30	0.044	-.048	0.256	0.260	0.225	0.197	0.288	0.234	0.158	0.031	-.310	0.966		2.2464

APPENDIX
THE VARIETAL MEANS : DATA A

VARIABLE	VARIETIES 1	2	3	4	5	6	7	8	9
1	17.967	19.510	12.183	19.353	19.120	5.693	17.750	12.137	12.253
2	88.467	87.267	117.467	106.467	105.133	93.000	109.467	123.600	83.400
3	6.933	8.467	6.067	12.533	7.333	8.067	4.983	6.467	8.400
4	9.267	10.867	6.600	24.067	9.800	10.067	6.133	8.067	12.733
5	89.133	91.133	68.000	146.600	87.933	101.333	83.400	91.733	99.867
6	2804.000	1764.000	1369.667	3113.667	3511.667	2864.667	3950.000	3168.000	3060.000
7	4.673	2.940	2.282	5.190	5.853	4.774	6.583	5.278	5.099
8	136.000	122.000	76.333	167.000	113.667	100.667	114.333	87.333	146.667
9	74.000	69.333	49.667	55.333	42.333	68.333	70.000	60.000	73.333
10	22.867	21.267	13.200	16.067	27.067	4.400	14.867	15.667	15.067
11	18.003	17.470	16.313	9.647	23.213	4.613	13.013	17.227	10.810
12	3.600	3.600	5.600	4.333	6.067	1.133	3.733	2.667	2.333
13	6.570	6.157	2.287	3.927	4.867	3.933	3.983	6.150	6.577
14	65.433	104.633	119.833	111.933	77.467	119.000	140.633	121.567	81.500
15	30.367	44.867	37.100	44.833	34.633	38.433	42.700	36.100	28.267
16	77.100	74.133	51.267	73.667	62.933	66.267	64.400	60.033	68.133
17	82.800	99.400	79.867	250.333	121.933	111.600	100.400	75.800	122.133
18	29.000	33.000	31.000	37.000	30.000	29.000	31.333	29.667	35.667
19	110.000	114.333	110.667	130.000	109.333	107.000	116.333	112.000	127.667
20	31.733	45 200	47.933	42.467	40.067	58.267	54.867	63.000	35.267
22	8.667	8.867	5.333	17.667	7.467	7.667	5.400	5.933	9.867
23	58.400	52.400	38.000	105.867	44.467	53.133	40.733	44.000	59.133
24	1842.467	1010.300	765.767	2233.234	1770.867	1503.467	1924.800	1545.533	1698.000
25	3.070	1.684	1.276	3.721	2.950	2.510	3.207	2.575	2.829
26	83.733	90.933	117.467	117.333	88.200	95.000	104.133	121.600	83.600
27	60.933	61.000	56.500	60.433	63.600	64.700	64.467	45.333	47.433
28	46.967	46.033	52.133	48.267	48.367	47.833	42.933	48.333	45.567
29	29.600	32.067	21.600	32.067	30.133	8.300	27.800	26.800	26.333
30	13.900	14.500	6.233	14.267	12.067	3.767	11.433	7.267	8.367

VARIABLE	VARIETIES 10	11	12	13	14	15	16	17	18
1	19.687	18.470	15.663	16.713	17.873	20.270	17.100	13.460	19.680
2	102.533	97.733	66.133	97.867	75.867	95.467	87.733	103.600	107.800
3	7.667	7.867	11.133	7.400	7.333	7.733	7.400	6.467	7.200
4	9.600	9.733	18.333	8.800	8.400	8.867	9.467	8.467	8.333
5	96.933	104.933	106.600	97.400	92.933	98.200	97.067	83.600	88.200
6	3188.667	4048.000	2056.000	3920.667	3407.000	3387.667	3807.000	3197.667	3402.667
7	5.314	6.746	3.443	6.534	5.668	5.645	6.344	5.329	5.670
8	160.000	140.333	141.000	154.000	136.000	98.667	141.333	153.333	133.333
9	68.667	67.667	80.333	62.667	66.333	45.000	61.000	56.000	67.000
10	21.933	31.733	13.933	21.533	22.867	32.733	21.800	14.133	19.400
11	13.410	22.697	9.870	13.897	15.757	33.777	15.410	10.367	14.893
12	4.133	3.733	2.800	2.333	2.467	4.133	2.467	2.600	2.800
13	5.150	9.050	5.203	9.453	8.837	7.923	11.427	5.120	7.143
14	76.833	78.333	112.600	87.167	82.733	58.967	71.667	96.900	95.700
15	32.933	30.733	52.567	41.333	36.067	24.300	36.033	40.300	38.067
16	66.933	70.567	73.167	73.267	62.533	78.767	75.333	69.600	61.100
17	111.200	126.000	119.333	78.667	70.133	69.000	107.333	94.133	90.533
18	33.333	30.333	33.333	31.667	31.567	32.000	29.667	29.000	29.333
19	109.000	114 333	129.333	105 000	112.333	114.000	114.667	110.000	115.333
20	43.533	45.467	34.333	47.267	43.400	42.400	49.067	55.467	49.567
22	8.600	8.600	13.400	8.400	8.400	8.267	8.533	6.867	6.533
23	53.533	57.000	76.800	50.067	55.267	51.533	55.300	46.733	49.267
24	1755.467	2217.900	1483.933	2017.267	2028.400	1774.667	2190.067	1785.967	1898.567
25	2.925	3.596	2.473	3.361	3.381	2.957	3.650	2.976	3.163
26	102.533	102.400	66.133	104.533	75.667	92.133	87.733	103.500	107.800
27	64.367	55.033	56.467	57.733	54.867	58.967	62.767	54.533	58.300
28	46.900	46.400	52.300	44.700	51.333	51.267	48.533	43.500	45.333
29	31.000	33.600	27.933	30.800	32.400	34.400	27.200	24.667	33.800
30	13.333	13.067	11.467	12.267	11.200	15.967	12.900	9.367	12.300

VARIABLE	VARIETIES 19	20	21	22	23	24	25	26	27
1	19.197	22.590	18.530	17.753	13.577	18.593	23.890	26.427	15.733
2	93.733	109.600	89.400	99.800	76.733	80.133	93.667	72.933	94.933
3	7.467	8.533	7.733	8.933	7.867	7.600	8.133	8.133	8.000
4	9.533	10.067	9.733	12.533	9.067	9.500	9.400	9.533	12.333
5	90.133	102.733	100.200	108.267	91.800	77.333	84.933	103.467	70.067
6	2545.333	2766.333	4640.667	2951.000	2317.000	1952.667	3579.000	2746.000	2854.000
7	4.241	4.609	7.725	4.918	3.839	3.254	5.965	4.816	4.756
8	124.333	74.000	160.000	108.000	94.667	114.667	101.000	116.667	112.333
9	66.667	40.333	64.333	52.333	51.000	69.000	70.333	62.000	55.333
10	22.200	21.867	24.733	18.867	19.333	28.133	27.867	24.600	22.000
11	17.907	29.583	17.560	16.700	20.427	24.477	27.537	21.457	19.220
12	3.333	3.733	3.867	3.133	2.267	3.933	3.867	4.067	4.267
13	5.737	5.917	5.707	6.073	8.633	6.687	7.253	6.113	5.217
14	80.867	98.900	91.267	118.200	80.933	85.867	76.567	90.467	80.400
15	37.433	41.400	37.467	48.467	36.033	36.667	36.800	35.400	31.233
16	71.567	62.567	65.367	66.433	77.300	79.867	65.267	67.500	61.567
17	102.667	115.067	112.533	128.333	81.400	104.867	99.933	69.600	84.467
18	33.567	30.333	31.333	31.667	31.667	32.667	32.000	33.000	29.667
19	122.333	111.667	110.000	120.000	110.000	108.333	116.333	114.000	117.667
20	38.000	49.400	44.000	42.067	44.867	38.200	43.267	45.133	51.867
22	9.267	9.400	8.933	10.133	7.800	7.067	7.867	8.600	8.667
23	56.667	52.933	57.733	62.333	49.667	39.133	53.800	55.933	50.533
24	1597.033	1473.533	2670.700	1694.800	1252.500	988.567	2266.500	1413.133	1424.600
25	2.662	2.456	4.451	2.825	2.087	1.481	3.778	2.355	2.374
26	92.800	109.600	88.600	99.133	76.733	80.133	93.667	72.933	94.933
27	63.567	61.300	56.267	56.033	51.400	58.067	64.667	66.633	57.500
28	42.733	46.567	46.233	53.233	45.333	50.333	42.267	48.167	44.267
29	30.200	36.867	34.333	31.733	36.200	32.000	36.267	39.667	27.400
30	13.767	14.133	12.100	11.833	10.500	14.833	15.600	17.867	9.733

VARIABLE	VARIETIES 28	29	30	31	32	33	34	35	36
1	24.667	19.697	14.807	15.647	18.917	16.747	6.377	19.013	13.363
2	93.400	97.000	114.533	116.333	89.400	76.800	98.000	107.867	62.000
3	7.600	6.333	7.800	7.000	7.267	6.733	7.933	6.267	7.333
4	9.467	8.267	9.533	8.000	8.400	7.733	9.733	8.467	10.267
5	108.667	65.000	111.067	81.533	91.067	78.533	89.067	77.867	89.600
6	3504.000	1548.333	4001.333	2876.000	2609.667	2200.000	1410.000	2959.667	2307.667
7	5.840	2.581	6.709	4.794	4.350	3.667	2.473	4.933	4.076
8	99.333	118.333	91.667	103.667	130.667	104.667	94.333	103.333	130.000
9	67.333	69.000	50.333	63.333	65.333	55.000	67.667	55.667	76.333
10	22.533	25.267	16.000	21.733	24.867	20.333	8.933	19.600	23.000
11	22.257	21.413	17.357	20.757	18.880	19.743	9.417	18.977	17.463
12	4.200	4.900	3.800	3.667	3.067	4.600	2.267	2.733	3.600
13	5.740	3.650	4.270	5.917	8.730	4.637	3.913	7.823	6.670
14	96.867	113.300	92.800	83.300	72.267	87.400	93.133	87.733	69.400
15	42.900	37.300	39.133	35.357	32.133	36.433	34.600	40.200	31.067
16	79.300	78.133	76.600	76.533	76.633	68.400	74.367	77.000	73.133
17	106.467	71.133	92.067	115.533	79.933	82.200	102.267	100.533	60.200
18	30.667	30.333	34.667	33.333	32.333	32.000	33.333	31.333	35.000
19	117.667	109.333	110.000	121.667	107.667	118.667	109.333	110.000	110.667
20	40.000	52.067	46.600	46.267	46.667	38.867	43.933	47.800	29.400
22	6.867	6.467	7.600	6.800	7.533	5.867	7.267	7.400	6.800
23	42.333	48.667	44.267	41.800	48.933	38.467	45.400	43.733	41.867
24	1364.300	1005.267	1050.967	1474.600	1827.500	1078.700	718.467	1661.767	1142.433
25	2.274	2.096	2.729	2.458	3.046	1.798	1.198	2.769	1.904
26	93.400	97.000	114.533	116.333	89.400	76.800	98.000	107.867	62.000
27	62.833	63.367	64.000	57.233	55.667	56.300	61.333	64.067	51.500
28	47.500	50.567	48.533	45.467	50.133	47.200	50.000	51.400	49.133
29	39.267	31.067	23.133	27.467	28.800	29.733	10.400	29.667	25.933
30	19.900	15.400	11.333	11.967	14.500	11.467	4.767	14.667	9.767

VARIABLE	VARIETIES 37	38	39	40	41	42	43	44	45
1	8.590	14.547	26.597	16.470	22.287	17.173	13.877	16.293	23.333
2	112.200	103.333	104.333	104.000	88.267	83.200	106.600	71.333	94.333
3	7.800	7.000	7.667	8.467	7.000	6.533	7.533	6.533	6.600
4	9.667	8.067	8.467	11.533	7.667	8.533	9.200	7.800	8.467
5	100.333	99.267	101.933	99.867	96.133	76.933	85.733	93.933	85.000
6	3317.000	1977.333	3463.333	2926.667	3597.333	1802.000	2838.000	3130.667	2336.667
7	5.529	3.295	5.769	4.878	5.995	3.003	4.724	5.218	3.895
8	92.333	90.000	107.667	121.333	84.000	138.667	88.667	111.667	105.333
9	56.333	55.667	71.667	69.333	53.333	71.667	57.333	58.667	62.667
10	9.333	12.667	29.133	19.933	18.333	22.333	16.600	17.267	27.667
11	10.457	23.350	27.083	16.410	21.937	16.033	18.643	15.497	26.317
12	1.933	3.600	2.533	2.333	2.933	3.067	2.200	1.733	3.933
13	4.907	5.937	12.757	8.547	8.670	7.637	7.570	10.147	7.137
14	137.600	104.900	109.267	77.100	94.533	74.467	116.133	129.000	75.600
15	35.800	37.533	40.833	37.233	38.567	31.300	40.033	50.267	32.967
16	59.000	59.733	71.833	76.700	75.167	61.300	70.800	71.967	61.833
17	90.533	77.067	109.200	128.333	95.467	68.867	86.667	78.867	110.467
18	28.667	29.000	32.333	32.667	31.000	32.000	29.667	29.000	32.667
19	108.333	107.667	120.667	114.667	116.000	110.000	105.000	116.000	107.667
20	60.533	59.400	47.133	43.933	43.467	45.133	58.400	52.933	48.200
22	8.267	6.467	7.400	9.733	6.867	7.533	8.400	6.733	7.333
23	64.600	47.867	56.733	53.867	49.800	44.800	55.400	47.667	46.533
24	2070.534	949.400	1906.600	1578.667	1857.200	1050.500	1832.100	1592.267	1277.667
25	3.451	1.582	3.178	2.631	3.096	1.751	3.053	2.654	2.130
26	112.200	103.333	104.333	104.000	88.267	81.933	106.467	71.667	92.400
27	59.633	51.100	63.533	52.033	64.433	69.733	52.900	54.200	66.467
28	47.133	45.967	42.767	49.700	47.167	43.133	49.167	43.500	45.067
29	12.333	28.467	41.867	31.600	34.600	24.667	26.267	30.133	35.133
30	5.067	8.700	19.133	12.633	16.767	10.533	9.833	11.767	14.433

VARIABLE	VARIETIES 46	47	48	49	50	51	52	53	54
1	19.720	22.257	21.310	23.413	13.280	25.863	18.357	16.777	15.853
2	88.200	93.867	106.533	95.667	94.733	84.667	98.733	99.867	97.200
3	7.733	8.533	7.667	7.733	6.600	7.400	7.733	8.600	7.600
4	8.933	9.867	9.400	9.200	8.267	10.200	9.600	9.800	9.733
5	92.200	75.467	101.933	94.533	84.533	88.267	80.000	95.200	101.600
6	3677.333	2093..333	2789.667	2480.333	2047.667	2692.667	1915.333	3371.333	3124.667
7	6.129	3.489	4.649	4.134	3.661	4.488	3.193	5.620	5.580
8	87.333	102.000	92.000	93.000	95.333	140.667	148.667	89.667	133.000
9	36.667	44.667	67.333	59.667	56.000	52.333	57.667	55.667	59.000
10	22.133	18.867	22.533	22.000	21.667	28.400	22.200	18.400	21.867
11	25.507	18.403	24.517	23.557	22.523	20.240	14.920	20.410	16.353
12	3.467	5.000	5.200	2.533	3.067	3.533	3.667	3.733	3.067
13	5.430	3.750	4.397	8.580	7.150	8.993	6.800	4.903	8 213
14	85.100	99.700	78.933	99.667	77.667	83.367	75.767	86.433	88.100
15	39.767	45.767	32.400	47 700	34.733	36.067	32.967	37.667	33.367
16	77.600	73.733	83.200	62.067	76.167	67.400	76.800	74.333	57.633
17	91.257	106.600	116.267	107.867	115.000	106.067	105.333	95.467	89.600
18	31.333	27.000	30.000	31.000	33.000	32.667	32.333	31.000	30.333
19	111.667	114.333	113.333	124.000	121.667	119.333	122.333	109.333	118.567
20	49.933	48.933	50.333	57.867	47.000	40.267	44.067	51.400	46.667
22	7.467	8.200	9.133	7.600	7.000	8.267	7.600	7.933	5.533
23	49.600	44.867	58.933	49.733	47.933	53.400	47.200	60.267	53 867
24	1976.400	1355.867	1613.700	1294.600	1245.867	1652.300	1130.500	2129.667	1775.600
25	3.294	2.260	2.690	2.174	2.076	2.754	1.854	3.550	2.961
26	91.533	93.867	105.867	95.667	94.733	84.667	98.733	99.867	95.533
27	57.467	70.367	66.600	55.100	52.400	60.633	63.833	64.533	66.300
28	48.067	50.500	48.100	48.367	51.700	31.333	49.967	45.000	47.400
29	34.333	31.667	32.000	42.467	25.333	42.533	28.733	26.000	23.933
30	15.300	16.433	17.733	14.533	9.900	16.100	14.100	12.467	9.133

VARIABLE	VARIETIES							
	55	56	57	58	59	60	61	62
1	16.357	12.580	10.610	11.540	19.013	13.903	14.220	13.093
2	95.600	114.333	103.600	120.933	79.933	89.267	79.400	87.533
3	6.667	9.600	8.400	7.267	6.800	5.667	7.533	7.933
4	7.733	12.133	11.400	8.933	8.267	8.200	9.267	9.600
5	101.933	89.600	103.533	108.000	86.933	84.467	95.867	90.533
6	3269.667	2099.333	4031.333	3117.333	2019.667	3319.333	2506.667	3759.000
7	5.450	3.501	6.720	5.196	3.366	4.865	3.845	6.265
8	94.333	65.333	174.333	124.333	126.333	93.333	108.000	100.667
9	54.000	34.000	63.333	59.333	56.667	46.667	69.333	54.667
10	20.067	14.867	14.067	14.733	24.667	16.867	19.133	17.533
11	21.253	22.827	8.037	13.053	19.400	17.933	17.670	17.397
12	3.600	3.133	2.667	2.400	3.533	3.333	3.200	2.067
13	5.883	4.827	5.737	7.013	8.610	5.290	6.360	8.710
14	90.167	111.133	91.833	91.167	77.733	78.800	80.767	84.833
15	39.267	45.100	37.600	37.200	32.200	32.900	37.233	37.167
16	74.033	73.467	65.833	61.433	68.333	76.867	79.200	75.533
17	83.133	115.533	83.133	104.067	89.433	58.400	71.000	64.067
18	31.000	34.000	31.000	30.333	34.333	31.000	29.333	30.000
19	113.333	123.000	110.000	112.333	126.000	117.667	109.333	109.333
20	46.733	38.067	52.333	50.400	37.000	42.467	46.733	49.400
22	6.800	8.467	8.600	7.467	7.933	7.200	7.733	8.600
23	49.467	56.800	51.667	55.400	50.067	48.067	50.067	52.933
24	1584.900	1288.167	2397.667	1595.400	1162.400	1888.033	1310.433	2195.067
25	2.642	2.147	3.996	2.659	2.049	3.147	2.184	3.658
26	95.200	114.133	103.600	120.933	79.667	89.267	76.733	87.533
27	61.633	60.467	62.667	56.667	59.800	60.267	57.700	55.667
28	45.567	47.267	49.833	48.000	48.057	50.733	51.133	47.500
29	26.533	20.800	16.867	20.333	31.733	23.067	24.667	23.600
30	12.100	9.233	7.000	7.100	12.967	10.700	11.233	8.767

APPENDIX - GENOTYPIC CORRELATION MATRIX : DATA A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1		-.229	-.034	-.068	-.000	0.108	0.112	-.043	-.040	0.749	0.647	0.461	0.439	-.245	0.102	0.127
2	-.229		-.052	-.100	0.089	0.207	0.206	-.324	-.381	-.345	-.003	0.064	-.394	0.362	0.036	-.289
3	-.034	-.052		0.994	0.788	-.104	-.092	0.220	-.048	-.222	-.242	-.103	-.257	0.092	0.401	0.171
4	-.068	-.100	0.994		0.767	-.092	-.083	0.393	0.058	-.219	-.357	-.026	-.283	0.107	0.333	0.111
5	-.000	0.089	0.788	0.767		0.356	0.377	0.287	0.049	-.316	-.288	-.464	0.088	0.166	0.329	0.074
6	0.108	0.207	-.104	-.092	0.356		0.999	0.244	-.065	0.098	-.043	-.247	0.338	-.033	-.011	-.018
7	0.112	0.206	-.092	-.083	0.377	0.999		0.256	-.051	0.102	-.047	-.264	0.360	-.032	-.014	-.040
8	-.043	-.324	0.220	0.393	0.287	0.244	0.256		0.467	0.073	-.560	-.205	0.234	-.264	-.135	-.061
9	-.040	-.381	-.048	0.058	0.049	-.065	-.051	0.467		0.015	-.360	-.335	0.217	-.028	-.072	0.054
10	0.749	-.345	-.222	-.219	-.316	0.098	0.102	0.073	0.015		0.753	0.443	0.630	-.642	-.425	0.218
11	0.647	-.003	-.242	-.357	-.288	-.043	-.047	-.560	-.360	0.753		0.508	0.320	-.342	-.214	0.192
12	0.461	0.064	-.103	-.026	-.464	-.247	-.264	-.205	-.335	0.443	0.508		-.378	-.242	-.261	0.011
13	0.439	-.394	-.257	-.283	0.088	0.338	0.360	0.234	0.217	0.630	0.320	-.378		-.401	-.115	0.133
14	-.245	0.362	0.092	0.107	0.166	-.033	-.032	-.264	-.028	-.642	-.342	-.242	-.401		0.712	-.332
15	0.102	0.036	0.401	0.333	0.329	-.011	-.014	-.135	-.072	-.425	-.214	-.261	-.115	0.712		0.006
16	0.127	-.289	0.171	0.111	0.074	-.018	-.040	-.061	0.054	0.218	0.192	0.011	0.133	-.332	0.005	
17	0.123	0.296	0.743	0.808	0.762	0.061	0.072	0.246	-.041	-.113	-.182	0.100	-.182	0.169	0.325	0.069
18	0.081	-.193	0.503	0.528	0.489	-.192	-.165	0.288	0.156	0.169	-.018	0.066	0.040	-.266	-.108	0.244
19	0.255	-.124	0.461	0.515	0.302	-.137	-.133	0.157	0.016	0.088	-.013	0.051	0.100	0.048	0.257	0.052
20	-.352	0.574	-.346	-.380	-.145	0.186	0.186	-.096	-.199	-.560	-.157	-.509	-.079	0.599	0.231	-.384
21	0.055	-.101	1.009	1.005	0.785	0.022	0.032	0.435	0.062	-.100	-.290	-.073	-.092	0.013	0.279	0.128
22	0.007	-.013	1.042	1.031	0.918	0.115	0.124	0.407	0.078	-.208	-.353	-.241	-.037	0.187	0.313	0.053
23	0.077	0.117	0.120	0.133	0.417	0.958	0.957	0.419	-.005	0.094	-.152	-.338	0.417	-.056	0.002	-.035
24	0.084	0.159	0.120	0.129	0.412	0.983	0.982	0.402	-.027	0.089	-.149	-.310	0.367	-.040	0.012	-.004
25	-.247	0.988	0.055	-.013	0.200	0.184	0.185	-.257	-.324	-.395	-.077	-.049	-.351	0.399	0.088	-.257
26	0.366	0.116	0.005	-.068	-.034	0.015	0.020	0.009	-.045	0.150	0.048	0.379	-.228	-.032	-.008	0.049
27	-.314	-.002	0.257	0.191	0.058	-.262	-.270	-.176	-.092	-.205	-.086	0.231	-.475	0.007	0.050	0.353
28	0.928	-.295	-.038	-.044	0.028	0.138	0.140	-.031	-.021	0.744	0.661	0.320	0.575	-.238	0.122	0.104
29	0.928	-.271	0.024	-.031	0.042	0.091	0.087	-.070	-.003	0.724	0.637	0.444	0.404	-.307	0.096	0.474

	17	18	19	20	21	22	23	24	25	26	27	28	29	SD
1	0.123	0.081	0.255	-.352	0.055	0.007	0.077	0.084	-.247	0.366	-.314	0.928	0.928	4.0926
2	0.296	-.193	-.124	0.574	-.101	-.013	0.117	0.159	0.988	0.116	-.002	-.295	-.271	12.0760
3	0.743	0.503	0.461	-.346	1.009	1.042	0.120	0.120	0.055	0.005	0.257	-.038	0.024	0.9235
4	0.808	0.528	0.515	-.380	1.005	1.031	0.133	0.129	-.013	-.068	0.191	-.044	-.031	2.3347
5	0.762	0.489	0.302	-.145	0.785	0.918	0.417	0.412	0.200	-.034	0.058	0.028	0.042	9.0154
6	0.061	-.192	-.137	0.186	0.022	0.115	0.958	0.983	0.184	0.015	-.262	0.138	0.091	687.0921
7	0.072	-.165	-.133	0.186	0.032	0.124	0.957	0.982	0.185	0.020	-.270	0.140	0.087	1.1356
8	0.246	0.288	0.157	-.096	0.435	0.407	0.419	0.402	-.257	0.009	-.176	-.031	-.070	23.0286
9	-.041	0.156	0.016	-.199	0.063	0.078	-.005	-.027	-.324	-.045	-.092	-.021	-.003	9.7326
10	-.113	0.189	0.088	-.560	-.100	-.208	0.094	0.089	-.395	0.150	-.205	0.744	0.724	4.8833
11	-.182	-.018	-.013	-.157	-.290	-.353	-.152	-.149	-.077	0.048	-.086	0.661	0.637	5.3106
12	0.100	0.066	0.051	-.509	-.073	-.241	-.338	-.310	-.049	0.379	0.231	0.320	0.444	0.7496
13	-.182	0.040	0.100	-.079	-.092	-.037	0.417	0.367	-.351	-.228	-.475	0.575	0.404	1.5531
14	0.169	-.266	0.048	0.599	0.013	0.187	-.056	-.040	0.399	-.032	0.007	-.238	-.307	17.5711
15	0.325	-.108	0.257	0.231	0.279	0.313	0.002	0.012	0.088	-.008	0.050	0.122	0.096	4.9343
16	0.069	0.244	0.052	-.384	0.128	0.053	-.035	-.004	-.257	0.049	0.253	0.104	0.474	6.8862
17		0.542	0.527	-.179	0.808	0.904	0.221	0.200	0.372	0.070	-.007	0.112	0.137	24.5555
18	0.542		0.522	-.807	0.495	0.394	-.260	-.187	-.108	-.126	0.001	0.133	0.128	1.5530
19	0.527	0.522		-.443	0.481	0.510	-.026	-.046	-.072	-.130	-.076	0.324	0.235	5.8823
20	-.179	-.807	-.443		-.400	-.250	0.112	0.129	0.588	0.011	-.066	-.369	-.432	5.8536
21	0.808	0.495	0.481	-.400		1.018	0.242	0.228	0.002	-.004	0.161	0.072	0.081	1.5884
22	0.904	0.394	0.510	-.250	1.018		0.290	0.274	0.107	0.031	0.062	0.006	0.017	7.5940
23	0.221	-.260	-.026	0.112	0.242	0.290		1.000	0.119	0.059	-.230	0.084	0.043	364.1703
24	0.200	-.187	-.046	0.129	0.228	0.274	1.000		0.162	0.089	-.215	0.080	0.061	0.5994
25	0.372	-.108	-.072	0.588	0.002	0.107	0.119	0.162		0.090	-.012	-.301	-.276	13.1769
26	0.070	-.126	-.130	0.011	-.004	0.031	0.059	0.089	0.090		-.131	-.002	0.364	5.3379
27	-.007	0.001	-.076	-.066	0.161	0.062	-.230	-.215	-.012	-.131		-.300	-.118	2.6993
28	0.112	0.133	0.324	-.369	0.072	0.006	0.084	0.080	-.301	-.002	-.300		0.847	6.0363
29	0.137	0.128	0.235	-.432	0.081	0.017	0.043	0.061	-.276	0.364	-.118	0.847		3.1671

Appendix

The solutions of communality obtained from the last two iterations of principal factor analysis - data A.

a) Environmental correlation matrix of order 23

(Three factor case)		(Four factor case)	
20th iteration	21st iteration	24th iteration	25th iteration
.4061805	.4061752	.5872608	.5872595
.4600722	.4600641	.5280225	.5280214
.4749271	.4749224	.5113405	.5113401
.4914531	.4914491	.5198121	.5198118
.6770654	.6770651	.7073341	.7073340
.4977899	.4977898	.5299001	.5299004
7307900	.7307896	.7335731	.7335733
.2718796	.2718794	2829846	.2829847
.0311959	.0311964	.0338531	0338532
.0212185	.0212186	.1356867	.1356868
.1368497	.1368427	.1390331	.1390322
.1517762	.1517759	.3012183	.3012190
.3482718	.3482582	.4170929	.4170910
.5778822	.5779497	.5249912	.5249983
.1120049	.1120045	.1130248	.1130247
.6829477	.6829483	.6698613	.6698614
.5762813	.5762826	.7522940	.7522940
.4994506	.4994518	.6987258	.6987261
.0684565	.0684653	.0785848	.0785848
.0523252	.0523247	.1436675	.1436676
.0740981	.0740973	.0767819	.0767818
.8579011	.8579004	.8519292	.8519296
.7807871	.7807871	.7914311	.7914312

b) Environmental correlation matrix of order 15.

49th iteration	50th iteration
.639831	.639883
.285561	.285531
.785430	.785427
.588676	.588683
.724055	.724055
.273386	.273387
.016393	.016404
.167713	.167701
.470836	.470301
.698766	.699518
.110658	.110654
.092123	.092120
.042218	.042216
.061400	.061396
.636560	.636560

c) Genotypic correlation matrix of order 15.

24th iteration	25th iteration
.793303	.793303
.023102	.023102
.362529	.362581
.339727	.339725
.734484	.734482
.724432	.724440
.482614	.482614
.834313	.834310
.668039	.668039
.408715	.408715
.986700	.986700
.513992	.513991
.122117	.122117
.028624	.028624
.463783	.463781

APPENDIX – 6. D^2 – Values based on 15 variables arranged in ascending order – data A.

	1		2		3		4		5		6
36	82.3	29	94.1	22	82.6	22	195.9	60	103.2	29	169.7
32	127.0	39	106.7	43	112.9	56	255.4	46	128.5	43	192.6
25	179.8	18	129.2	8	156.4	3	396.2	51	162.7	44	252.4
42	182.1	28	130.3	29	239.9	35	467.4	52	200.0	8	294.3
45	210.4	49	144.9	56	284.3	43	469.3	27	215.9	3	294.8
40	220.8	38	146.9	38	293.5	47	471.7	16	218.8	2	317.1
16	239.4	34	166.0	6	294.8	17	495.9	33	219.5	39	326.6
10	244.7	43	233.8	44	307.1	49	516.7	62	247.2	22	375.6
48	245.0	41	272.3	4	396.2	20	546.4	59	250.4	12	411.6
61	250.2	26	272.5	2	419.3	2	553.5	53	265.2	38	433.8
11	281.3	12	288.7	37	453.7	8	580.9	35	275.9	37	443.6
19	352.0	58	297.3	39	454.5	29	623.3	55	309.7	7	542.2
14	393.1	6	317.1	49	532.2	12	631.0	50	309.9	4	636.7
24	418.1	55	343.0	47	561.5	6	636.7	10	319.0	18	644.2
50	431.5	21	359.8	20	573.8	18	657.9	33	320.4	49	673.0
52	465.3	17	370.3	12	625.3	39	695.9	30	325.1	34	680.9
31	488.9	54	386.7	17	640.0	57	707.3	13	328.0	22	735.3
59	494.9	57	390.8	7	663.0	58	713.3	54	340.8	17	802.3
27	511.6	22	395.4	18	687.2	41	741.3	45	349.8	56	832.4
23	522.7	24	397.0	41	755.1	44	769.0	11	350.0	57	850.8
15	530.6	47	399.3	28	800.3	30	812.3	32	354.4	58	882.6
9	562.2	30	407.0	58	842.4	54	822.5	14	395.2	47	894.8
62	582.0	33	412.4	30	864.2	21	829.8	21	420.1	41	912.8
53	582.7	35	415.3	34	919.1	28	847.5	15	422.7	21	965.5
60	600.1	3	419.3	57	920.7	55	869.2	19	426.8	20	967.5
13	659.2	20	431.0	55	934.3	33	900.9	31	434.8	30	1006.3
35	661.2	53	453.2	21	967.0	34	958.3	58	448.2	26	1032.8
26	699.1	31	454.7	26	1028.1	26	971.2	26	449.3	55	1061.5
33	732.2	8	476.3	54	1037.2	35	1021.9	41	465.9	54	1094.3
5	759.2	13	501.6	33	1064.4	37	1024.7	57	473.2	35	1197.8
51	761.0	14	536.4	35	1130.3	51	1063.8	20	486.0	13	1218.8
55	804.1	19	544.6	53	1221.9	13	1104.4	48	533.4	53	1238.4
54	816.6	4	553.5	13	1285.2	53	1130.9	42	542.2	24	1269.8
34	845.7	62	562.6	62	1313.5	62	1165.5	40	546.6	33	1273.1
21	857.1	61	583.8	31	1362.5	31	1178.1	61	565.3	31	1381.2
58	907.9	56	641.5	24	1402.4	46	1217.8	25	575.9	62	1408.1
28	999.5	44	642.3	51	1434.7	27	1235.7	24	583.7	14	1450.3
41	1020.3	9	651.1	46	1485.2	9	1296.5	47	584.3	19	1531.0
30	1026.0	27	686.0	14	1496.2	7	1317.7	17	600.5	61	1553.9
18	1031.9	48	702.3	27	1529.5	14	1327.3	18	728.4	9	1606.4
57	1036.4	51	720.6	19	1596.9	19	1328.0	1	759.2	51	1679.6
46	1093.1	11	725.8	23	1605.4	59	1361.4	9	790.6	27	1691.7
17	1422.9	23	774.9	9	1701.1	23	1380.5	34	847.1	42	1746.2
49	1435.4	40	780.1	60	1720.4	24	1391.3	36	856.8	11	1750.8
2	1537.3	50	783.7	61	1729.7	60	1403.9	28	866.2	23	1806.1
20	1585.7	59	817.2	50	1737.6	52	1421.7	49	961.4	10	1815.5
47	1670.1	25	817.6	59	1756.2	50	1432.5	38	1050.5	40	1864.8
38	1738.6	10	828.6	11	1804.1	11	1560.6	2	1228.1	50	1908.5
39	1969.2	45	916.8	52	1897.5	5	1607.2	56	1276.1	25	1918.0
29	2261.8	42	917.2	48	1908.4	61	1633.9	4	1507.2	59	1962.5
12	2517.3	52	918.8	5	1955.2	10	1692.4	39	1640.3	46	1965.5
43	2597.7	60	933.5	10	1975.8	40	1703.0	43	1721.1	42	1970.0
56	2877.9	46	1010.8	40	1990.3	48	1733.6	29	1746.0	45	2009.9
4	2901.7	32	1090.0	25	2127.5	16	1894.5	22	1832.0	60	2022.3
6	2946.3	16	1144.7	45	2133.3	45	1975.1	3	1955.2	52	2060.0
22	3065.2	5	1225.1	42	2255.9	25	1976.7	6	2304.4	32	2273.2
3	3210.9	37	1246.2	16	2340.0	42	2047.5	12	2373.3	5	2304.4
8	3338.8	36	1322.8	32	2408.9	32	2158.4	8	2402.0	16	2325.1
44	4028.5	7	1369.8	36	2894.6	36	2662.0	44	3161.2	36	2641.4
37	5335.5	1	1537.3	1	3210.9	1	2901.7	37	3800.6	1	2946.3
7	5650.5	15	2429.6	15	3804.8	15	3390.4	7	4438.1	15	4157.9

	7		8		9		10		11		12
37	131.0	43	98.4	40	135.8	32	53.9	14	44.0	2	288.7
44	241.0	44	140.9	14	150.3	45	70.9	40	61.3	29	312.0
6	542.2	3	156.4	31	170.0	42	84.4	31	70.5	39	327.3
8	587.2	22	171.5	50	189.1	16	87.8	19	74.2	6	411.6
3	663.0	6	294.3	11	196.2	11	90.3	61	84.1	44	433.1
22	771.7	29	323.5	19	197.0	14	117.1	50	98.8	49	458.7
43	814.7	38	324.3	61	211.7	61	124.1	10	90.3	2	487.8
29	857.1	39	436.2	27	242.3	19	128.5	27	99.8	43	492.2
39	1061.6	2	476.3	33	245.1	40	135.6	62	102.5	22	493.1
12	1083.3	12	487.8	59	269.5	48	136.5	16	102.6	35	539.4
4	1317.7	49	555.7	62	277.6	53	138.3	25	105.7	18	588.5
.2	1369.8	37	560.5	23	290.4	25	140.9	23	132.7	25	589.7
38	1487.2	4	580.9	24	293.0	13	151.7	45	133.1	3	625.3
56	1501.3	7	587.2	56	299.7	62	174.7	32	134.6	4	631.0
49	1776.3	56	590.4	18	320.0	24	175.4	24	135.3	34	690.9
18	1989.0	18	724.2	21	321.1	35	175.8	53	137.8	58	923.7
28	2029.5	17	752.7	13	343.5	52	185.6	48	139.9	17	929.0
47	2064.6	28	861.7	52	347.1	31	188.1	59	143.1	41	938.1
17	2150.4	20	870.8	10	363.0	27	194.9	13	152.3	26	944.1
20	2201.2	47	951.5	54	378.6	23	217.1	35	168.3	21	1022.3
34	2291.5	58	957.8	25	379.1	50	226.1	52	169.3	57	1024.4
41	2302.7	41	974.3	36	382.3	59	238.0	33	175.0	47	1039.9
58	2460.8	34	1018.5	16	384.4	1	244.7	42	182.8	56	1042.4
57	2469.9	21	1063.7	34	389.2	26	249.8	60	191.3	9	1046.9
30	2533.0	57	1094.3	55	390.2	60	254.3	9	196.2	54	1052.3
21	2558.6	30	1119.4	26	392.6	21	263.2	55	196.6	33	1056.1
26	2634.5	55	1134.7	51	398.7	54	264.7	21	208.0	7	1083.3
55	2645.6	26	1235.1	53	409.3	55	265.4	51	217.5	55	1087.6
54	2719.3	33	1243 6	48	413.0	36	278.3	26	217.9	24	1097.0
35	2935.5	54	1284.2	35	417.8	51	290.1	54	218.0	31	1134.6
33	2935.8	13	1359.4	60	433.6	33	291.5	58	231.0	20	1161.2
13	3034.3	35	1361.5	57	437.7	58	301.4	36	259.0	37	1187.2
53	3046.8	62	1437.4	28	444.9	5	319.0	1	281.3	19	1232.8
24	3154.1	53	1446.7	49	466.0	57	322.5	18	322.5	30	1239.9
31	3180.2	31	1460.2	42	477.4	30	338.8	41	335.3	14	1241.0
62	3280.5	24	1512.0	41	498.7	34	354.8	30	337.4	35	1246.1
14	3390.8	14	1559.8	32	499.0	9	363.0	57	347.2	61	1292.4
19	3460.2	9	1612.3	17	520.8	41	419.5	5	350.0	53	1308.0
51	3505.0	51	1625.6	45	538.7	18	439.4	34	355.3	13	1320.3
9	3521.2	27	1721.1	1	562.2	28	516.4	28	396.5	62	1365.6
61	3630.6	23	1754.0	30	598.3	46	521.9	46	447.4	27	1444.6
27	3664.0	19	1757.6	2	651.1	17	603.3	17	525.8	40	1504.1
46	3764.0	61	1795.0	38	685.5	15	653.1	49	564.3	11	1527.0
11	3825.8	46	1798.2	45	745.9	20	750.2	15	639.9	50	1534.6
48	3828.0	50	1875.5	5	790.6	49	801.7	20	647.7	48	1540.9
23	3855.3	11	1887.6	20	856.7	47	806.7	2	725.8	51	1545.6
50	3955.3	59	1995.8	47	946.0	2	832.6	38	763.7	59	1572.5
59	3956.6	60	1997.1	39	973.1	38	917.2	47	766.7	23	1635.0
60	4035.3	40	2001.2	12	1046.9	39	1312.3	39	1016.5	25	1661.2
10	4046.9	48	2091.8	15	1166.7	29	1368.3	29	1254.2	52	1749.2
40	4063.4	10	2195 4	29	1208.6	43	1542.3	43	1364.7	10	1760.5
25	4066.5	52	2196.9	43	1274.6	4	1692.4	56	1502.5	42	1827.3
52	4173.9	25	2253.5	4	1296.5	56	1693.7	12	1527 0	60	1851.0
45	4296.2	5	2402.0	22	1457.4	12	1760.5	4	1560.6	45	1958.6
42	4302.5	45	2403.6	56	1490.6	6	1815.5	22	1644.9	46	2008.4
5	4438.1	42	2498.3	6	1606.4	22	1876 7	6	1750.8	16	2119.1
16	4686.8	16	2559.8	8	1612.3	3	1975.8	3	1804.1	32	2137.8
32	4698.7	32	2654.7	3	1701.1	8	2195.4	8	1887.6	36	2145.5
36	5225.3	36	2911.1	44	2140.2	44	2791.0	44	2502.1	5	2373.3
1	5650.5	1	3338.8	37	3381.7	37	3650.6	37	3521.7	1	2517.3
15	7002 3	15	4177.9	7	3521.2	7	4046.9	7	3825.8	15	3815.7

	13		14		15		16		17		18
21	41.6	11	44.0	16	345.9	32	21.7	52	25.9	52	62.3
62	45.5	62	53.9	5	422.7	10	87.8	57	95.0	28	96.2
58	75.1	61	52.8	32	447.6	52	90.9	21	118.2	21	100.9
53	77.7	31	75.6	60	448.4	11	102.6	35	155.0	49	101.2
35	82.0	40	76.7	52	493.5	60	134.7	18	156.2	41	105.4
14	86.6	13	56.6	1	530.6	59	137.6	30	184.9	55	107.8
55	94.5	19	88.3	59	546.8	27	140.1	55	125.8	26	122.4
57	96.6	24	93.5	50	563.5	45	141.3	20	191.9	2	129.2
30	111.0	23	99.1	45	566.4	50	147.4	13	194.9	34	134.3
23	139.6	27	101.4	23	583.8	19	167.5	41	216.6	54	136.4
10	151.7	33	106.0	27	626.5	14	171.2	33	219.5	57	144.6
11	152.3	50	109.4	11	639.9	40	171.6	54	228.8	33	151.5
33	153.8	53	111.0	10	653.1	23	177.4	62	236.2	17	156.2
54	160.6	10	117.1	46	697.9	43	189.8	47	260.5	38	159.0
26	166.5	21	119.0	51	711.6	62	195.9	25	270.6	31	162.0
27	173.3	35	124.3	40	730.4	25	204.5	49	270.8	35	168.6
31	174.7	55	136.0	36	731.1	5	218.8	51	296.1	13	183.5
18	183.5	26	140.4	25	740.3	51	225.4	53	310.8	30	186.8
51	189.4	58	146.9	42	768.1	61	226.2	26	329.3	53	190.7
41	192.7	9	150.3	62	779.0	48	226.7	27	362.2	14	207.4
17	194.9	59	160.2	42	798.2	31	228.0	14	364.9	62	209.6
24	199.0	16	171.2	19	813.3	53	233.1	2	370.3	24	238.1
61	212.9	54	179.5	14	821.4	1	239.4	23	370.9	19	246.6
19	215.1	25	180.8	53	862.6	35	264.3	46	376.8	39	278.4
60	226.7	42	184.8	61	886.1	13	265.2	34	385.2	20	292.3
40	239.7	60	194.7	31	888.2	33	307.8	31	395.9	27	300.6
34	250.9	32	198.4	35	923.8	54	321.6	28	403.7	61	310.9
50	257.4	52	200.2	33	947.0	36	329.4	50	444.2	47	316.6
16	265.2	45	202.9	13	991.8	55	340.6	43	449.1	9	320.0
45	286.8	18	207.4	55	1050.0	15	345.9	56	469.5	11	322.5
52	291.3	51	211.3	24	1075.7	24	348.2	4	495.9	51	338.1
59	294.5	57	233.1	54	1102.1	26	372.4	50	507.6	29	376.0
46	305.4	42	234.2	26	1146.6	9	384.4	19	513.3	23	380.6
32	309.0	41	243.8	9	1166.7	21	390.1	59	519.8	50	380.8
5	328.0	34	245.4	30	1204.3	46	402.0	9	520.8	40	406.3
48	331.1	30	260.2	21	1250.6	58	416.2	11	525.8	59	409.9
28	335.3	22	291.7	58	1288.2	30	467.9	22	535.0	48	423.5
9	343.5	36	299.8	41	1310.4	57	469.9	24	538.6	43	427.5
20	358.6	17	364.9	57	1433.3	41	511.5	52	547.0	10	439.4
25	359.9	1	393.1	20	1559.7	18	606.1	5	600.5	60	460.0
42	361.7	5	395.2	18	1649.7	34	641.4	10	603.3	52	477.4
38	419.6	46	405.3	17	1687.0	28	709.8	61	607.5	25	484.7
49	455.9	49	425.0	28	1711.6	17	713.0	39	632.4	45	568.9
47	476.8	20	535.1	34	1716.1	20	821.3	3	640.0	46	574.5
2	501.6	2	536.4	47	1752.4	47	894.1	39	644.0	42	587.2
36	581.2	38	545.1	49	1940.4	49	906.9	40	651.5	12	588.5
1	659.2	47	630.9	38	2294.2	2	1144.7	16	713.0	22	590.4
39	816.3	15	821.4	2	2429.6	38	1147.4	8	752.7	16	605.1
43	861.6	39	849.1	56	2232.8	39	1532.2	6	802.3	6	644.2
29	902.1	29	1005.0	39	2924.3	29	1760.8	48	805.1	4	657.9
15	991.2	43	1080.4	29	3254.3	56	1800.7	45	833.0	32	660.5
56	1035.9	12	1241.0	4	3290.4	4	1894.5	25	897.2	56	677.1
4	1104.4	56	1290.4	43	3337.0	43	1900.3	32	897.6	3	687.2
22	1147.0	4	1327.3	22	3566.3	12	2119.1	42	906.4	8	724.2
6	1218.8	22	1355.7	3	3804.2	22	2136.5	12	929.0	5	728.4
3	1235.2	6	1450.3	12	3815.7	6	2325.1	44	1220.6	36	899.4
12	1320.3	3	1496.2	6	4157.9	3	2340.0	36	1256.7	1	1031.9
8	1359.4	8	1559.8	8	4177.9	8	2559.9	1	1422.9	44	1075.3
44	1933.7	44	2112.7	44	5198.5	44	3252.7	15	1627.0	15	1649.7
37	2658.6	37	3110.8	37	6365.6	37	4237.5	37	1798.7	37	1797.2
7	3034.3	7	3390.8	7	7003.3	7	4686.2	7	2150.4	7	1989.0

	19		20		21		22		23		24
31	35.2	47	73.4	13	41.6	3	22.6	62	47.4	61	46.0
11	74.2	30	125.6	58	45.9	43	146.2	27	72.3	14	93.5
14	88.3	41	129.0	57	60.7	8	171.6	50	77.3	48	109.9
48	93.9	55	157.0	55	80.6	56	189.6	60	91.6	26	112.6
25	94.0	17	191.9	62	84.9	4	195.9	14	99.1	19	120.6
59	97.0	58	223.1	18	100.9	38	285.4	33	109.1	31	125.4
61	97.7	35	228.4	30	104.5	29	302.1	51	124.0	34	130.7
27	105.0	33	243.6	35	114.9	44	308.7	11	132.7	53	131.7
50	108.0	56	247.3	53	118.2	6	375.6	59	139.7	40	134.2
26	117.5	46	249.6	17	118.2	2	395.4	13	139.8	11	135.3
24	120.6	38	250.9	14	119.0	49	395.7	53	152.5	25	141.3
40	122.5	54	256.8	33	128.0	39	402.3	35	157.3	35	150.7
53	122.7	49	272.1	54	129.8	47	479.1	40	167.2	45	164.9
52	123.3	53	284.6	41	141.7	12	493.1	31	166.1	10	175.4
10	126.5	21	290.3	26	151.7	20	498.7	55	168.4	62	187.3
33	131.1	26	290.7	31	185.3	17	535.0	52	169.7	55	192.7
54	132.2	18	292.3	11	202.0	18	590.4	16	177.4	13	199.0
35	138.2	51	295.4	27	211.1	37	593.4	46	180.0	33	200.4
42	150.5	57	316.5	23	215.7	41	673.6	61	207.7	42	202.9
45	151.9	62	325.0	51	216.5	28	702.9	19	211.6	28	203.6
55	158.8	13	358.6	34	226.1	58	752.4	58	211.7	32	228.2
62	163.5	28	383.9	24	232.8	7	771.7	21	215.7	21	232.8
16	167.5	60	409.9	19	247.9	30	813.7	10	217.1	50	235.7
32	179.8	27	414.2	28	248.2	57	825.9	5	219.5	18	238.1
51	193.6	2	431.0	10	263.2	55	846.7	24	242.4	23	242.4
9	197.0	23	435.3	61	277.5	21	853.4	26	258.5	58	243.1
23	211.6	31	447.6	20	290.3	54	913.5	32	264.5	27	245.6
60	213.8	5	486.0	38	291.4	34	927.0	54	265.7	54	264.4
13	215.1	43	496.2	60	293.5	33	929.3	45	268.8	41	269.2
58	217.5	22	498.7	50	306.3	26	936.1	30	269.8	9	293.0
41	245.0	34	526.4	49	313.4	35	1044.2	9	290.4	59	311.4
18	246.6	59	529.0	9	321.1	13	1147.0	41	300.6	30	315.5
21	247.9	14	535.1	40	325.2	53	1156.2	48	332.9	36	323.6
34	261.9	4	546.4	59	332.7	62	1192.9	57	339.7	16	348.2
28	265.1	50	551.1	46	347.9	31	1223.3	25	354.4	52	360.6
30	317.0	3	573.8	2	359.8	51	1235.4	17	370.9	57	374.3
57	330.0	19	575.2	52	363.8	46	1311.5	18	380.6	51	383.7
1	362.0	52	577.9	47	377.9	24	1346.0	42	401.3	2	397.0
36	367.6	24	590.9	16	390.1	14	1355.7	20	435.3	60	400.7
49	422.4	39	606.6	48	416.7	27	1365.3	36	441.8	1	418.1
5	426.8	29	615.3	5	420.1	19	1440.8	34	456.5	49	432.8
46	510.2	11	647.7	45	429.0	9	1457.4	28	503.6	17	538.6
17	513.3	10	750.2	25	450.6	23	1460.7	1	522.7	38	546.2
2	544.6	61	753.3	32	475.9	60	1537.6	49	539.7	5	583.7
20	575.2	48	776.7	42	495.0	59	1539.1	15	583.8	20	590.9
47	590.0	45	800.6	39	517.9	50	1547.8	47	601.5	46	632.1
38	693.0	16	821.3	43	652.7	61	1632.3	38	612.3	47	661.3
39	796.7	40	840.1	29	699.1	11	1644.9	2	774.9	39	679.2
15	813.3	9	856.7	36	735.7	52	1688.1	39	1170.6	29	787.6
29	1024.3	8	870.8	56	825.2	40	1821.4	56	1183.9	43	996.9
12	1232.8	25	915.0	4	829.8	5	1822.0	43	1231.1	15	1075.7
43	1255.1	32	949.0	22	853.4	48	1822.8	29	1294.9	12	1097.0
56	1302.1	6	967.5	1	857.1	10	1876.7	4	1380.5	6	1269.8
4	1328.0	42	1021.5	6	965.5	25	2010.9	22	1460.7	22	1346.0
22	1440.8	12	1161.8	3	967.0	45	2072.3	3	1605.4	56	1364.7
6	1531.0	44	1355.2	12	1022.3	16	2136.5	12	1635.0	4	1391.3
3	1596.9	36	1520.3	8	1063.7	42	2193.4	8	1754.0	3	1402.4
8	1757.6	15	1559.7	15	1250.6	32	2304.4	6	1806.1	8	1512.0
44	2242.9	1	1585.7	44	1541.0	36	2765.2	44	2459.7	44	1974.6
37	3185.7	37	1750.6	37	2252.4	1	3065.2	37	3432.4	37	2912.2
7	3460.2	7	2201.2	7	2558.6	15	3566.3	7	3855.3	7	3154.1

	25		26		27		28		29		30
48	33.5	55	54.8	50	50.3	18	86.2	2	94.1	55	48.1
45	78.2	35	55.5	59	52.0	26	98.4	39	108.9	35	59.6
19	94.0	53	63.7	60	65.2	41	105.7	43	156.1	41	73.6
61	94.5	41	64.9	33	67.8	2	130.8	6	169.7	53	75.6
42	95.2	54	94.0	62	68.6	49	136.2	3	239.9	58	99.1
11	105.7	33	98.1	51	70.7	55	172.7	38	256.1	21	104.5
32	106.5	28	98.4	52	71.5	34	177.5	22	302.1	13	111.0
40	139.5	24	112.6	23	72.3	39	203.4	12	312.0	20	125.8
10	140.9	19	117.5	31	93.2	24	203.6	8	323.5	62	135.7
24	141.3	31	119.6	11	99.8	35	205.4	49	334.9	54	137.7
31	153.7	18	122.4	14	101.4	31	208.4	28	347.9	57	138.2
1	179.8	30	138.7	19	105.0	58	227.9	44	374.5	26	138.7
14	180.8	14	140.4	54	122.6	53	230.4	18	376.0	33	165.8
16	204.5	58	146.8	53	126.0	33	231.9	34	438.8	17	184.8
53	219.4	62	149.8	55	127.6	21	248.2	41	539.6	18	186.8
36	235.6	21	151.7	16	140.1	54	254.0	47	540.8	47	212.9
50	244.5	13	166.5	35	141.8	19	265.1	26	576.4	51	219.3
26	256.6	34	172.2	58	170.7	30	268.3	20	615.3	46	237.6
35	274.8	61	180.1	13	173.3	38	289.1	4	623.3	31	241.7
27	275.0	48	185.9	40	186.5	14	291.7	58	624.1	14	260.2
59	280.4	27	190.5	26	190.5	61	314.2	17	632.4	60	261.9
62	304.4	11	217.9	10	194.9	48	328.5	56	650.5	27	263.2
52	304.9	57	220.7	61	195.5	13	335.3	55	662.0	28	268.3
55	344.5	51	226.5	21	211.1	62	336.1	30	686.2	23	269.8
23	354.4	59	236.9	5	215.9	29	347.9	21	699.1	34	296.0
13	359.9	49	243.3	46	242.2	57	365.2	57	705.9	24	315.5
33	361.5	10	249.8	9	242.3	47	379.4	54	725.5	19	317.0
54	363.6	25	256.6	24	245.6	20	383.9	37	765.2	38	322.5
9	379.1	23	258.5	45	247.5	11	396.5	35	773.9	5	325.1
60	387.3	50	259.9	32	256.5	17	403.7	24	787.6	11	337.4
34	398.6	45	268.3	41	257.9	25	415.0	33	797.0	10	338.8
28	415.0	2	272.8	48	262.3	27	425.9	53	827.2	49	348.5
51	439.1	60	273.1	30	263.2	9	444.9	7	857.1	59	375.5
21	450.6	52	276.7	57	273.4	40	450.5	13	902.1	50	376.8
41	457.4	47	279.6	25	275.0	50	463.8	31	906.2	52	386.6
58	465.2	20	290.7	18	300.6	51	484.3	62	999.3	2	407.0
18	484.7	40	308.1	42	309.9	59	490.8	14	1005.0	61	413.3
30	515.1	42	326.3	17	362.2	23	503.6	19	1024.3	45	418.7
5	575.9	17	329.3	34	407.2	10	516.4	61	1061.5	48	425.0
57	609.0	32	347.9	20	414.2	43	527.3	48	1173.6	16	467.9
15	740.3	16	372.4	28	425.9	45	551.5	27	1181.4	40	488.4
49	743.2	38	382.7	49	442 0	60	569.7	51	1192.2	32	514.6
46	760.1	9	392.6	47	487.3	52	584.4	9	1208.6	25	515.1
2	817.6	46	412.0	36	488.7	12	589.7	11	1254.2	42	575.3
17	897.2	5	449.2	1	511.6	42	610.8	23	1294.9	9	598.3
20	915.0	39	476.0	38	617.9	32	674.3	50	1333.0	56	623.6
47	975.4	29	576.4	15	626.5	22	702.9	25	1338.7	39	625.9
38	1047.2	36	665.2	2	686.0	16	709.8	59	1355.5	43	646.7
39	1048.2	1	699.1	39	1027.0	46	710.7	40	1364.6	29	686.2
29	1338.7	43	760.4	56	1086.5	6	735.3	10	1368.3	22	813.7
43	1653.9	56	868.6	29	1181.4	3	800.2	45	1441.9	4	818.3
12	1661.8	22	935.1	4	1225.7	56	829.9	46	1449.2	3	864.2
56	1898.2	12	944.1	43	1233.6	4	847.5	60	1450.7	36	986.3
6	1918.0	4	971.2	22	1366.3	8	861.7	42	1456.9	6	1006.3
4	1976.7	3	1028.1	12	1444.6	5	866.2	52	1480.5	1	1026.0
22	2010.9	6	1032.6	3	1529.5	36	908.4	32	1681.8	8	1119.4
3	2127.5	15	1146.6	6	1691.7	1	999.5	5	1746.0	15	1204.3
8	2253.5	8	1235.1	8	1721.1	44	1140.0	16	1780.8	12	1239.9
44	2779.2	44	1618.8	44	2352.7	15	1711.6	36	2016.5	44	1634.9
37	3816.3	37	2346.4	37	3250.9	37	1919.5	1	2261.8	37	2117.4
7	4066.6	7	2634.5	7	3664.0	7	2029.5	15	3254.3	7	2532.0

	31		32		33		34		35		36
19	35.8	45	29.8	55	51.3	24	130.7	53	15.0	1	82.3
11	70.5	10	53.9	27	67.8	18	134.3	55	28.0	40	151.6
14	75.6	42	67.2	62	75.8	2	166.0	26	55.5	61	182.8
50	78.6	16	81.7	31	83.9	26	172.2	30	59.6	32	210.8
33	83.9	25	106.5	54	92.0	58	173.7	41	70.9	25	235.6
27	93.2	48	117.2	51	95.4	28	177.5	62	74.3	42	246.8
55	103.6	1	127.0	58	95.8	53	212.4	13	82.0	11	259.0
53	103.9	11	134.6	35	96.1	61	220.1	54	93.6	10	278.3
35	107.9	61	150.1	26	98.1	35	225.0	33	96.1	45	288.9
62	113.5	40	164.7	14	106.0	21	226.1	58	96.2	14	299.8
59	117.2	19	179.8	50	106.3	55	229.6	31	107.9	48	313.6
26	119.6	14	198.4	59	106.8	31	236.3	21	114.9	24	323.6
61	120.9	36	210.8	23	109.1	14	245.4	14	124.3	16	329.4
40	121.5	52	216.1	41	109.8	13	250.9	19	138.2	19	367.6
24	125.4	24	228.8	53	111.4	57	251.8	37	141.8	9	382.3
54	126.3	53	228.8	21	128.0	54	254.1	24	150.7	50	389.0
58	136.9	50	247.5	60	129.5	19	261.9	51	155.9	23	441.2
48	142.7	27	256.5	19	131.1	41	275.1	23	157.3	31	449.6
25	153.7	59	264.3	18	151.5	33	289.2	60	166.5	27	488.7
18	165.0	23	264.5	13	153.8	30	296.0	11	168.3	59	507.4
23	168.1	31	269.5	30	165.8	62	306.9	18	168.6	62	509.7
9	170.0	62	273.9	52	169.5	38	313.6	57	175.1	52	533.3
52	170.3	35	275.6	11	175.0	49	319.3	10	175.8	13	581.2
13	174.7	60	288.0	24	200.4	48	326.1	48	198.3	53	583.5
41	177.5	13	309.0	57	212.1	10	354.8	50	199.2	60	639.2
51	183.2	26	347.9	17	219.5	11	355.3	61	203.1	33	643.5
21	185.3	5	354.4	49	223.5	40	357.8	28	205.4	35	660.0
10	188.1	51	389.9	61	224.4	17	385.2	59	207.0	26	665.2
60	197.9	55	397.3	28	231.9	9	389.2	52	209.7	34	693.7
28	208.4	33	407.1	46	236.4	42	395.7	45	211.4	15	731.1
45	221.5	54	413.7	20	243.6	25	398.6	34	225.0	21	735.7
16	225.0	15	447.6	9	245.1	27	407.2	20	228.4	55	761.5
34	236.3	21	475.9	40	259.7	39	423.7	46	250.2	51	764.7
30	241.7	9	499.0	34	289.2	45	423.9	40	262.5	58	799.4
32	269.5	58	509.3	10	291.5	29	438.8	16	264.3	54	808.4
42	274.0	30	514.6	47	298.2	23	456.5	17	270.6	5	856.8
57	294.4	34	535.4	16	307.3	50	462.5	35	274.8	18	899.4
49	295.1	41	570.4	48	311.5	20	526.4	32	275.6	28	908.4
17	395.9	57	573.4	5	320.4	51	527.6	5	275.9	57	940.3
46	429.7	46	603.5	38	353.6	32	535.4	47	287.9	41	984.1
5	434.8	18	660.5	45	359.3	59	537.6	42	328.9	30	986.3
20	447.6	28	674.3	25	361.5	47	544.6	49	334.4	46	1095.4
36	449.6	17	897.6	32	407.1	52	573.6	38	416.8	17	1256.7
2	464.7	20	949.0	2	412.4	43	606.8	9	417.8	49	1261.3
1	488.9	49	1009.6	42	443.4	60	635.5	2	418.3	2	1322.8
38	521.1	47	1019.6	36	643.5	16	641.4	36	660.0	38	1474.0
47	524.8	3	1090.0	39	688.6	6	680.9	1	661.2	20	1520.3
39	679.5	38	1211.6	1	732.2	12	690.9	39	664.7	47	1660.5
15	888.2	39	1483.8	56	756.8	36	693.7	29	773.9	39	1790.4
29	906.2	29	1661.8	29	797.0	46	835.7	43	841.6	29	2016.5
43	1033.9	43	1924.3	43	837.2	1	845.7	56	865.1	12	2145.6
56	1102.8	56	2042.0	4	900.9	5	847.1	15	923.8	43	2270.0
12	1134.6	12	2137.8	22	929.3	3	919.1	4	1021.9	6	2641.4
4	1178.1	4	2158.4	15	947.0	22	927.0	22	1044.2	4	2662.0
22	1223.3	6	2273.2	12	1056.1	4	958.3	3	1130.3	56	2704.8
3	1362.5	22	2304.4	3	1064.4	5	1018.5	6	1197.8	22	2765.2
6	1381.2	3	2406.9	8	1243.6	56	1058.9	12	1246.1	3	2894.6
8	1460.8	8	2654.7	6	1273.1	44	1362.8	8	1361.5	8	2911.1
44	1995.5	44	3306.5	44	1766.7	15	1716.1	44	1882.5	44	3587.5
37	2930.9	37	4271.3	37	2617.2	37	2055.5	37	2550.2	37	4983.7
7	3180.2	7	4698.7	7	2935.8	7	2291.5	7	2935.5	7	5225.3

	37		38		39		40		41		42
7	131.0	43	129.3	2	106.7	61	58.2	55	36.8	45	65.1
44	338.6	2	146.9	29	108.9	11	61.3	26	64.9	32	67.2
6	443.6	49	151.3	28	203.4	14	76.7	35	70.9	10	84.4
3	453.7	17	155.0	49	218.1	50	118.2	30	73.6	25	95.2
8	560.6	18	159.0	18	278.4	31	121.5	53	105.1	48	118.1
22	593.4	58	217.1	43	283.3	19	122.5	18	105.4	61	140.0
43	654.7	20	250.9	6	326.6	24	134.8	28	105.7	19	150.5
29	765.2	29	256.1	12	327.3	10	135.6	33	109.8	1	182.1
4	1024.7	41	267.0	38	329.7	9	135.8	58	120.4	11	182.8
39	1059.7	22	285.4	22	402.3	25	138.5	54	121.8	16	189.8
56	1093.6	28	289.1	41	404.4	36	151.6	20	129.0	24	202.9
12	1187.2	21	291.4	34	423.7	48	152.1	21	141.7	40	218.6
2	1246.3	3	293.5	8	436.2	32	164.7	47	160.9	14	234.2
38	1260.1	55	303.1	3	454.5	23	167.2	49	161.9	36	246.8
47	1621.5	34	313.6	26	476.0	16	171.6	62	172.0	53	263.1
49	1631.6	30	322.5	44	502.0	62	182.4	31	177.5	31	274.0
20	1750.6	8	324.3	58	552.8	27	186.5	13	192.7	52	286.2
17	1788.7	57	325 4	55	554.9	45	189.3	17	216.6	27	309.9
18	1797.2	47	328.4	47	573.5	42	218.6	57	218.1	26	326.3
28	1919.5	39	329.7	20	606.6	1	220.8	51	223.8	35	328.9
41	2012.5	33	353.6	54	611.2	59	237.4	14	243.8	59	329.5
34	2055.5	26	382.7	21	617.9	53	237.6	19	245.0	50	336.5
57	2076.1	56	407.8	30	625.9	13	239.7	27	257.9	62	357.6
30	2117.4	35	416.8	17	644.0	52	252.1	38	267.0	13	361.7
58	2125.1	13	419.6	35	664.7	33	259.7	24	269.2	54	368.3
21	2252.4	54	424.6	24	679.2	35	262.5	2	272.3	34	395.7
55	2294.3	6	433.8	31	679.5	26	308.1	34	275.1	23	401.3
54	2336.8	62	445.0	33	688.6	60	310.8	60	285.2	55	426.5
26	2346.4	53	459.5	57	694.4	58	324.6	23	300.6	60	441.2
35	2550.2	4	467.4	4	695.9	21	325.2	46	305.7	33	443.4
33	2617.2	31	521.1	53	713.8	55	325.5	59	318.3	51	463.3
53	2655.2	12	539.4	56	722.3	34	357.8	50	332.4	9	477.4
13	2658.6	14	545.1	19	796.7	51	364.0	11	335.3	21	495.0
62	2892.5	24	546.2	13	816.3	54	380.8	48	363.6	58	499.8
24	2912.2	23	612.3	14	849.1	18	406.3	61	366.0	5	542.2
31	2930.9	27	617.9	62	878.4	28	450.5	52	375.0	57	543.9
51	3053.4	51	618.2	61	911.9	41	460.3	39	404.4	30	575.3
14	3110.8	44	681.5	48	951.3	57	479.5	10	419.5	18	587.2
19	3185.7	9	686.5	9	973.1	30	488.4	25	457.4	41	600.8
46	3210.3	19	693.0	11	1016.5	5	546.6	40	460.3	28	610.8
27	3250.9	61	700.9	51	1026.7	46	612.6	45	465.6	15	768 1
61	3381.0	46	712.4	27	1027.0	49	641.8	5	465.9	46	839.5
9	3881.7	50	735.4	25	1048.2	17	651.5	9	498.7	17	908.4
23	3432.4	11	763.7	37	1059.7	15	730.4	16	511.5	2	917.2
11	3521.7	60	793.7	7	1061.6	2	780.1	29	529.6	49	946.5
60	3549.2	59	820.9	50	1113.6	38	835.3	56	567.3	47	1019.3
48	3554.1	40	835.3	40	1133.1	20	840.1	32	570.4	20	1031.5
59	3579.4	45	911.9	59	1134.2	47	973.2	43	571.6	38	1155.5
50	3610.6	10	917.2	23	1170.6	39	1133.1	42	600.8	39	1287.7
10	3650.6	52	923.3	10	1212.3	29	1364.6	22	673.6	29	1456.8
52	3722.9	25	1047.2	45	1257.2	43	1479.0	4	741.3	43	1810.1
5	3800.6	5	1050.5	60	1271.2	12	1504.1	3	786.1	12	1827.3
40	3810.0	45	1060.9	52	1286.7	4	1703.0	6	918.8	6	1970.
25	3816.3	16	1147.4	42	1287.7	56	1746.2	12	938.1	56	2035.
45	3876.4	42	1155.5	46	1341.3	22	1821.4	8	974.3	4	2047.
42	3922.9	32	1211.6	32	1483.8	6	1864.8	36	984.1	22	2193.
16	4237.5	37	1260.1	16	1532.8	3	1990.3	1	1020.3	3	2255.
32	4271.3	36	1474.0	5	1640.3	8	2001.2	15	1310.4	8	2498.
36	4983.7	7	1487.2	36	1790.4	44	2634.1	44	1379.1	44	3017
1	5335.5	1	1738.6	1	1969.2	37	3810.0	37	2012.5	37	3922
15	6365.6	15	2294.2	15	2924.3	7	4063.4	7	2302.7	7	4302

	43		44		45		46		47		48
8	98.4	8	140.9	32	29.8	60	111.5	20	73.4	25	33.5
3	112.9	7	241.0	42	65.1	5	128.8	41	160.9	45	75.9
38	129.3	6	258.4	10	70.9	51	146.9	30	212.9	61	86.2
22	146.2	43	293.5	48	75.9	23	180.0	55	220.2	19	93.9
29	156.1	3	307.1	25	78.2	62	202.1	54	238.9	24	109.9
6	192.6	22	308.7	11	133.1	55	233.2	17	260.5	32	117.2
2	233.8	37	338.6	16	141.3	33	236.4	56	261.6	42	118.1
39	283.3	29	374.5	61	142.4	30	237.6	26	279.6	10	136.5
44	293.5	12	433.1	19	151.9	27	242.2	35	287.9	11	139.9
49	365.4	39	502.0	53	160.0	20	249.6	49	294.6	31	142.7
18	427.8	2	648.2	24	164.9	35	250.2	33	298.2	40	153.1
56	438.4	38	681.5	40	189.3	53	282.5	58	298.5	53	162.0
17	449.1	4	769.0	14	202.9	59	297.4	18	316.8	14	184.8
4	469.3	49	870.1	1	210.4	13	305.4	38	328.4	26	185.9
12	492.2	56	922.8	35	211.4	41	305.7	57	330.8	35	198.3
20	496.2	18	1075.3	31	221.5	52	307.6	53	353.8	16	226.7
28	527.3	28	1140.0	52	244.0	50	319.5	51	368.2	50	241.8
47	563.9	17	1220.6	27	247.5	21	347.9	21	377.9	1	245.0
41	571.6	47	1303.6	50	248.3	54	352.5	28	379.4	27	262.3
58	584.3	20	1355.2	62	256.5	58	352.9	2	399.3	59	279.3
34	606.8	34	1362.8	26	268.3	17	376.8	46	400.0	52	281.2
30	646.7	41	1379.1	23	268.8	47	400.0	62	457.9	62	282.6
21	652.7	58	1457.1	59	273.0	16	402.0	4	471.7	55	283.3
37	654.7	57	1540.6	13	288.8	14	405.3	13	476.8	33	311.5
57	674.0	21	1541.0	36	288.9	26	412.0	22	479.1	36	313.6
55	693.8	26	1618.8	60	304.8	31	429.7	27	487.3	54	324.5
26	760.4	55	1627.4	55	315.5	57	433.6	60	498.8	34	326.1
7	814.7	30	1634.9	54	346.2	11	447.4	31	524.8	28	328.5
33	837.2	54	1722.4	5	349.8	19	510.2	29	540.8	13	331.1
35	841.6	33	1766.7	33	359.3	10	521.9	34	544.6	23	332.9
54	842.0	35	1832.5	51	360.4	18	574.5	3	561.5	60	359.2
13	861.6	13	1923.7	30	418.7	45	581.2	43	563.9	41	363.6
53	908.5	24	1974.6	34	423.9	32	603.5	59	565.3	58	407 1
62	954.6	53	1976.4	21	429.0	40	612.6	39	573.5	9	413.0
24	996.9	31	1995.5	58	444.8	24	632.1	52	582.8	31	416.7
31	1033.9	62	2054.4	41	465.6	61	646.8	5	584.3	51	422.6
14	1080.4	14	2113.7	9	528.7	49	660.7	19	590.0	18	423.5
51	1187.5	9	2140.2	57	541.5	48	684.3	23	601.5	30	425.0
23	1231.1	19	2242.9	28	551.5	15	697.9	14	630.9	5	533.4
27	1233.6	51	2280.3	15	566.4	28	710.7	24	661.3	57	548.3
19	1255.1	61	2318.8	18	568.9	38	712.4	50	665.3	49	652.8
46	1264.2	27	2352.7	46	581.2	9	746.9	11	766.7	46	684.3
61	1265.1	23	2459.7	20	800.6	25	760.1	48	799 6	2	702.3
9	1274.6	11	2502.1	17	833.0	34	835.7	10	806.7	20	,776.7
11	1364.7	46	2528.4	49	872.4	56	835.9	61	819.2	15	798.2
50	1395.9	50	2547.7	47	876.2	42	839.5	45	876.2	47	799.6
60	1449.0	59	2603.0	2	916.8	2	1010.8	16	894.1	17	805.1
40	1479.0	48	2603.7	38	1060.9	1	1093.1	6	894.8	38	911.9
48	1487.2	40	2634.1	39	1257.2	36	1096.4	9	946.0	39	951.3
59	1488.2	60	2698.8	29	1441.9	4	1217.8	8	951.5	29	1173.6
10	1542.3	25	2779.2	43	1696.1	43	1264.2	40	973.2	43	1487.2
52	1625.0	10	2791.0	56	1824.0	22	1311.5	25	975.4	12	1540.9
25	1653.9	52	2829.5	12	1958.6	39	1341.2	42	1019.3	56	1710.6
45	1696.1	45	3010.2	4	1975.1	29	1449.2	32	1019.6	6	1746.2
5	1721.1	42	3017.5	6	2009.9	3	1485.2	12	1029.9	4	1783 6
42	1810.1	5	3161.2	22	2072.3	8	1798.2	44	1303.6	22	1822.8
16	1900.3	16	3252.7	3	2133.3	6	1965.5	37	1621.5	3	1908.4
32	1924.8	32	3306.5	8	2403.6	12	2008.4	36	1660.5	8	2091.8
36	2270.0	36	3587.5	44	3010.2	44	2528.4	1	1670.1	44	2603.7
1	2597.7	1	4028.5	37	3875.4	37	3210.3	15	1752.4	37	3554.1
15	3337.0	15	5198.5	7	4296.2	7	3764.0	7	2064.6	7	3828.0

	49		50		51		52		53		54
18	101.2	59	46.0	27	70.7	59	22.2	35	15 0	55	59 6
28	136.2	27	50 3	60	77.3	27	71 5	55	37.3	58	85 1
2	144.9	23	77.3	59	91.9	60	77 0	36	63 7	33	92 0
38	151.3	31	78.6	33	95.4	16	90 9	62	64 3	35	93.6
41	161.9	11	82 8	52	106.8	50	91.6	30	75.6	25	94 0
58	216.3	52	91.6	62	120.2	51	106.8	13	77.7	53	100.1
39	218.1	60	105.7	23	124 0	19	123.3	54	100 1	57	116.6
33	223,5	33	106.3	54	125.5	11	169.3	31	103.9	41	121 9
55	227.1	19	102.0	55	125.9	33	169 6	41	105 1	27	122 6
26	243.3	14	106.4	46	146.9	23	169.7	14	111.0	51	125.5
17	270.8	40	118.2	50	151.0	31	170.3	33	111.4	31	126 3
20	272.1	62	124.8	35	155.9	10	185.6	55	111.6	21	129 5
54	277.0	16	147.4	53	162.6	54	186.0	21	118.2	19	132.2
47	294.6	51	151.0	5	168 7	62	198.3	19	122.7	18	-136 4
31	295.1	61	180.3	31	183.2	5	200 0	27	126 0	30	137 7
21	313.4	9	189.1	13	189.4	14	200.2	24	131 7	62	142 3
34	319.8	35	199.2	58	192.1	35	209.7	11	137 8	13	160 6
35	334.4	53	199.4	19	193 6	32	216.1	10	138 3	59	173 5
29	334.9	55	206.8	14	211.3	53	218.5	23	152.5	14	179 5
30	348.5	10	226 1	21	216.5	45	244 0	45	160.0	52	186 0
43	365.4	54	233.3	11	217.5	55	246 1	48	162.0	60	206 6
53	388.4	24	235 7	30	219.3	40	252.1	51	162.6	11	218 0
57	388.5	48	241.8	41	223.8	26	276.7	61	166.0	17	228 2
22	395.7	25	244.5	16	225.4	48	281.2	60	172.8	50	233 3
62	400.1	32	247 5	26	226.5	42	286.2	57	184.2	47	238.9
19	422.4	45	248.3	57	266.8	13	291 3	18	190 7	28	254.0
14	425.0	58	256.1	10	290.1	61	292.3	50	199.4	34	254 1
24	432.8	13	257.4	20	295.4	25	304.9	34	212.4	20	256.8
27	442.0	26	259.9	17	296.1	46	307.6	59	215.5	24	264 4
13	455.9	21	306.3	18	338.1	58	316.8	52	218 5	10	264.7
12	458.7	5	309 9	45	360.4	9	347.1	25	219.4	23	265 7
51	461.1	46	319.5	40	364.0	24	360 6	32	228.8	49	277 0
9	466.0	41	332 4	47	368.2	21	363.2	22	230 4	61	300.2
56	468.6	42	336.5	24	383.7	41	375.0	16	233.1	16	321 6
50	484.2	30	376.8	61	386.0	30	386.6	40	237.6	42	324 5
4	516.7	18	380.8	32	389.9	57	390.0	42	263.1	5	340 5
59	517.9	36	389 0	9	398.7	1	465.3	5	265.2	45	346.2
3	538.2	1	431.5	48	422.8	18	477.4	46	282.5	46	352.5
23	539.7	57	432.4	25	439.1	15	493.5	20	284 6	25	363 6
61	550.6	34	462 5	49	461.1	36	533.3	17	310 8	42	368 3
8	555.7	28	463.8	42	463.3	17	547.0	47	353 8	9	378 6
11	564.3	49	484.2	28	484.3	34	573 6	49	389 4	40	380 9
60	609.8	17	507.6	34	527.6	20	577.9	9	409 3	2	386 7
40	641.8	20	551.1	38	618.2	47	592.8	2	453 2	32	413 7
52	648 0	15	563.5	15	711.6	28	624 4	38	459 5	38	424 6
48	652.8	47	665 3	2	720 6	49	648.0	1	582.7	39	611 2
46	660 7	38	735.4	1	761.0	2	918.8	36	583 5	29	725 5
6	673.0	2	783.7	36	764.7	38	923 3	39	713.8	56	740.2
25	743.2	39	1113.6	56	871.1	39	1286 7	29	827.2	36	808 4
10	801.7	56	1283.6	39	1026.7	56	1314.5	15	862 6	1	816 6
44	870 1	29	1333.0	4	1063.8	4	1421 7	43	908 6	4	822.5
45	872.4	43	1395 9	43	1187.5	29	1480.5	56	975 6	43	842.0
16	908.9	4	1422.5	29	1192.2	43	1635.0	4	1130.9	22	913 5
42	946.5	12	1534 6	22	1235.4	22	1658.1	22	1156 2	3	1037 2
5	961.4	22	1547 8	3	1424.7	12	1749.2	3	1221.9	12	1052 3
32	1009.6	3	1737 6	12	1545 6	3	1897.5	6	1238.4	6	1094 3
36	1261.3	8	1875 5	6	1679.6	6	2060.0	12	1308.0	15	1102 1
1	1435.4	6	1908.5	8	1685 6	8	2198.6	8	1446.7	8	1284 2
37	1631 6	44	2547.7	44	2280.3	44	2829.5	44	1976 4	44	1722.4
7	1776.3	37	3610.6	37	3053 4	37	3722 9	37	2555 2	37	2336 5
15	1940.4	7	3955.3	7	3505 0	7	4173.9	7	3046 8	7	2719.3

	55		56		57		58		59		60
35	28.0	22	189.6	21	60.7	21	45.9	52	28.8	27	65.2
41	36.8	20	247.3	58	61.7	55	59.3	50	46.0	59	73.2
53	37.3	4	255.4	17	95.0	57	61.7	27	52.0	52	77.0
30	48.1	47	261.6	13	96.6	18	62.3	60	73.2	51	77.3
33	51.3	3	284.3	54	116.6	13	75.1	51	91.9	23	91.8
26	54.8	38	407.8	30	138.2	54	85.1	19	97.0	5	103.2
58	59.3	43	438.4	18	144.6	17	85.9	33	106.8	50	105.7
54	59.6	17	468.5	55	145.4	62	91.9	31	117.2	62	109.2
62	68.0	49	468.6	62	172.5	33	95.8	16	137.6	46	111.5
21	80.6	41	567.3	35	175.1	35	96.2	23	139.7	33	129.5
13	94.5	8	590.4	53	184.2	30	99.1	11	143.1	16	134.7
31	103.6	30	623.6	33	212.1	53	111.6	14	160.8	35	166.5
18	107.8	2	641.5	41	218.1	41	120.4	62	171.4	55	171.6
51	125.9	29	650.5	26	220.7	31	136.9	54	173.5	53	172.8
27	127.6	18	677.1	14	233.1	26	146.8	55	206.3	11	191.3
14	136.0	58	679.9	34	251.8	14	146.9	35	207.0	14	194.7
57	145.4	55	685.2	51	266.8	27	170.7	53	215.5	31	197.9
20	157.0	39	722.3	27	273.4	34	173.7	40	227.4	54	205.6
19	158.8	54	740.2	31	294.4	51	192.1	26	236.9	19	213.8
23	168.4	33	756.8	20	316.5	23	211.7	10	238.0	13	226.7
60	171.6	57	766.5	10	322.5	49	216.3	5	250.4	10	254.3
28	172.7	21	825.2	38	325.4	38	217.1	61	261.5	30	261.9
17	185.8	28	829.9	19	330.0	19	217.5	32	264.3	26	273.1
24	192.7	46	835.9	47	330.8	20	223.1	9	269.5	58	277.3
11	196.6	6	862.4	23	339.7	28	227.9	45	273.0	41	285.2
59	206.3	35	865.1	11	347.2	11	231.0	48	279.3	32	288.0
50	206.8	26	868.6	28	365.2	24	243.1	25	280.4	21	293.5
47	220.2	51	871.1	60	367.2	50	256.1	58	291.8	45	304.8
49	227.1	44	922.8	24	374.3	60	277.3	13	294.5	40	310.2
34	229.6	53	975.6	49	388.5	61	287.2	46	297.4	61	343.2
46	233.2	62	1007.9	52	390.0	59	291.8	24	311.4	48	359.2
52	246.1	13	1035.9	2	390.8	2	297.3	41	318.3	57	367.2
61	252.0	12	1042.4	61	407.4	47	298.5	42	329.5	25	387.3
10	265.4	34	1058.9	59	411.6	9	299.7	21	332.7	24	400.7
48	283.3	27	1086.5	50	432.4	10	301.4	30	375.5	20	409.9
38	303.1	37	1093.6	46	433.6	52	316.8	18	409.9	9	433.6
5	309.7	31	1102.8	9	437.7	40	324.6	57	411.6	42	441.2
45	315.5	60	1122.2	16	468.9	46	352.9	28	490.8	17	444.2
40	325.5	23	1183.9	5	473.2	48	407.1	1	494.9	15	448.4
16	340.6	59	1210.0	40	479.5	16	416.2	36	507.4	18	460.0
2	343.0	5	1276.1	45	541.5	45	444.8	49	517.9	47	492.2
25	344.5	50	1283.6	42	543.9	5	448.2	17	519.6	28	569.7
9	390.2	14	1290.4	48	548.3	25	465.2	20	529.0	1	600.1
32	397.3	19	1302.1	32	578.4	42	499.8	34	537.6	49	609.8
42	426.5	52	1314.5	25	609.0	32	509.3	15	546.8	34	635.5
39	554.9	24	1364.7	43	674.0	39	552.8	47	565.3	36	639.2
29	662.0	9	1490.6	39	694.4	43	584.3	2	817.2	38	793.7
56	685.2	7	1501.3	29	705.9	29	624.1	38	820.9	2	933.5
43	693.8	11	1502.5	4	707.3	56	679.9	39	1134.2	56	1122.2
36	761.5	61	1629.2	56	766.5	4	713.3	56	1210.0	39	1271.2
1	804.1	10	1693.7	22	825.9	22	752.4	29	1355.5	4	1402.9
22	846.7	48	1710.6	6	880.8	36	799.4	4	1361.4	43	1449.0
4	869.2	40	1746.2	3	920.7	3	842.4	43	1488.3	29	1450.7
3	934.3	16	1800.7	36	940.3	6	888.6	22	1539.1	22	1537.6
15	1050.0	45	1824.0	12	1024.4	1	907.9	12	1572.5	3	1720.4
6	1061.5	25	1898.2	1	1036.4	12	922.7	3	1756.2	12	1851.0
12	1087.6	42	2035.5	8	1094.3	8	957.8	6	1962.8	8	1997.1
8	1134.7	32	2042.0	15	1433.3	15	1288.8	8	1995.8	6	2022.3
44	1627.4	36	2704.8	44	1540.6	44	1457.1	44	2603.0	44	2698.8
37	2294.3	15	2832.8	37	2076.1	37	2125.1	37	3579.4	37	3549.2
7	2645.6	1	2877.9	7	2469.9	7	2460.8	7	3956.6	7	4025.3

	61		62
24	46.0	13	45.5
40	58.2	23	47.4
14	58.8	14	53.9
11	84.1	53	64.3
48	86.2	55	68.0
25	94.5	27	69.6
19	97.7	35	74.3
31	120 9	33	75.5
10	124.1	21	84 9
42	140.0	58	91.9
45	142.4	11	102.5
32	150.1	60	109.2
53	166.0	31	113.5
62	170.2	51	120.2
26	180.1	50	124.8
50	180 3	30	135.7
36	182.8	54	142.3
27	195.5	26	149.8
35	203.1	19	168.5
23	207.7	61	170.2
9	211.7	59	171.4
13	212.9	41	172.0
34	220.1	57	172 5
33	224.4	10	174.7
16	226.2	40	182.4
1	250.2	24	187.3
55	252.0	16	195.9
59	261.5	52	198.3
21	277.5	46	202.1
58	287.2	18	209.6
52	292.3	17	236.8
54	300.2	5	247.2
18	310.9	45	256.5
28	314.2	32	273.9
60	343.2	9	277.6
41	366.0	48	282.6
51	386.0	25	304.4
57	407.4	34	306.9
30	413.3	20	326.0
49	550.6	28	336.1
5	565.3	42	357.6
2	583.8	49	400.1
17	607.5	38	445.0
46	648.8	47	457.9
38	700.9	36	509.7
20	753.3	2	562.6
47	819.2	1	582.0
15	886.1	15	779.0
39	911.9	39	878.4
29	1061.5	43	954.6
43	1265.1	29	999.3
12	1292.4	56	1007.9
6	1553.9	4	1165.5
56	1629.2	22	1192.9
4	1633.9	3	1313.5
22	1638.3	12	1365.6
3	1729.7	6	1408.1
8	1795.0	8	1437.4
44	2318.8	44	2054.4
37	3381.0	37	2892.5
7	3630.6	7	3280.5

APPENDIX - BETWEEN CORRELATION MATRIX : DATA B

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		0.223	0.164	0.119	0.171	0.326	0.334	0.107	-.011	0.585	0.298	0.337	-.071	0.008	0.100	0.139	0.405
2	0.223		0.099	0.204	0.450	0.520	0.510	0.030	0.108	0.146	0.064	0.223	-.270	0.198	0.327	0.134	0.502
3	0.164	0.099		0.917	0.779	0.581	0.582	0.091	-.207	0.246	0.084	0.410	-.108	0.016	0.381	-.169	0.419
4	0.119	0.204	0.917		0.845	0.618	0.618	0.135	-.142	0.259	0.059	0.412	-.124	0.014	0.327	-.159	0.503
5	0.171	0.450	0.779	0.845		0.788	0.787	0.071	-.019	0.327	0.145	0.468	-.226	0.045	0.415	-.009	0.571
6	0.326	0.520	0.581	0.618	0.788		0.999	0.194	0.018	0.287	0.024	0.387	-.257	0.056	0.459	0.009	0.582
7	0.334	0.510	0.582	0.618	0.787	0.999		0.198	0.028	0.286	0.021	0.387	-.258	0.061	0.465	0.006	0.586
8	0.107	0.030	0.091	0.135	0.071	0.194	0.198		0.245	0.081	-.642	0.051	-.033	-.093	-.051	-.166	0.240
9	-.011	0.108	-.207	-.142	-.019	0.018	0.028	0.245		-.083	-.248	-.049	0.012	0.250	0.070	-.230	0.265
10	0.585	0.146	0.246	0.259	0.327	0.287	0.286	0.081	-.083		0.646	0.210	0.270	-.448	-.189	0.278	0.211
11	0.298	0.064	0.084	0.059	0.145	0.024	0.021	-.642	-.248	0.646		0.032	0.285	-.298	-.124	0.297	-.078
12	0.337	0.223	0.410	0.412	0.468	0.387	0.387	0.051	-.049	0.210	0.032		-.700	0.261	0.206	0.087	0.367
13	-.071	-.270	-.108	-.124	-.226	-.257	-.258	-.033	0.012	0.270	0.285	-.700		-.490	-.254	-.091	-.198
14	0.008	0.198	0.016	0.014	0.045	0.056	0.061	-.093	0.250	-.448	-.298	0.261	-.490		0.492	-.314	0.278
15	0.100	0.327	0.381	0.327	0.415	0.459	0.465	-.051	0.070	-.189	-.124	0.206	-.254	0.492		-.185	0.408
16	0.139	0.134	-.169	-.159	-.009	0.009	0.006	-.166	-.230	0.278	0.297	0.087	-.091	-.314	-.185		-.264
17	0.405	0.502	0.419	0.503	0.571	0.582	0.586	0.240	0.265	0.211	-.078	0.367	-.198	0.278	0.408	-.264	
18	0.034	0.028	0.361	0.440	0.404	0.269	0.262	-.097	-.204	0.366	0.300	0.118	0.042	-.401	-.081	0.093	0.162
19	0.131	0.411	0.276	0.416	0.561	0.399	0.395	-.067	-.141	0.286	0.211	0.343	-.271	0.103	0.210	0.201	0.327
20	0.163	0.531	-.124	-.181	-.097	0.115	0.106	0.208	0.045	-.199	-.287	0.102	-.263	0.337	0.181	0.061	0.127
21	0.375	0.381	0.298	0.290	0.253	0.393	0.400	0.230	0.011	0.105	-.108	0.071	-.117	0.142	0.345	0.019	0.416
22	0.043	0.023	0.889	0.932	0.738	0.471	0.470	0.101	-.196	0.153	0.015	0.314	-.067	0.042	0.272	-.251	0.413
23	0.081	0.237	0.853	0.901	0.817	0.561	0.559	0.113	-.058	0.168	0.011	0.341	-.139	0.161	0.353	-.205	0.496
24	0.285	0.329	0.509	0.519	0.491	0.823	0.821	0.273	0.026	0.119	-.131	0.209	-.165	0.129	0.356	-.187	0.492
25	0.287	0.326	0.482	0.487	0.465	0.814	0.812	0.270	0.026	0.117	-.129	0.189	-.155	0.126	0.384	-.182	0.474
26	0.184	0.900	-.021	0.116	0.353	0.436	0.425	-.078	0.132	0.108	0.114	0.167	-.239	0.242	0.313	0.195	0.362
27	0.244	-.298	-.064	-.117	-.294	-.203	-.206	0.114	-.151	0.068	-.032	-.283	0.344	-.379	-.345	0.248	-.300
28	0.159	0.019	0.131	0.184	0.174	0.158	0.148	-.120	-.317	0.120	0.192	0.255	-.094	-.184	-.098	0.005	0.061
29	0.893	0.378	0.212	0.192	0.307	0.412	0.422	0.063	0.057	0.558	0.316	0.446	-.189	0.183	0.197	0.009	0.562
30	0.916	0.258	0.078	0.057	0.160	0.304	0.310	0.063	-.057	0.609	0.338	0.305	-.080	-.111	0.009	0.481	0.280

	18	19	20	21	22	23	24	25	26	27	28	29	30	SD
1	0.034	0.131	0.163	0.375	0.043	0.081	0.285	0.287	0.184	0.244	0.159	0.893	0.916	4.2654
2	0.028	0.411	0.531	0.381	0.023	0.237	0.329	0.326	0.900	-.298	0.019	0.378	0.258	18.2122
3	0.361	0.276	-.124	0.298	0.889	0.853	0.509	0.482	-.021	-.064	0.131	0.212	0.078	1.9641
4	0.440	0.416	-.181	0.290	0.932	0.901	0.519	0.487	0.116	-.117	0.184	0.192	0.057	3.0412
5	0.404	0.561	-.097	0.253	0.738	0.817	0.491	0.465	0.353	-.294	0.174	0.307	0.160	50.2446
6	0.269	0.399	0.115	0.393	0.471	0.561	0.823	0.814	0.436	-.203	0.158	0.412	0.304	%1176.0490
7	0.262	0.395	0.106	0.400	0.470	0.559	0.821	0.812	0.425	-.206	0.148	0.422	0.310	1.9461
8	-.097	-.067	0.208	0.230	0.101	0.113	0.273	0.270	-.078	0.114	-.120	0.063	0.063	38.2375
9	-.204	-.141	0.045	0.011	-.196	-.058	0.026	0.026	0.132	-.151	-.317	0.057	-.057	17.1102
10	0.366	0.286	-.199	0.105	0.153	0.168	0.119	0.117	0.108	0.068	0.120	0.558	0.609	5.4948
11	0.300	0.211	-.287	-.108	0.015	0.011	-.131	-.129	0.114	-.032	0.192	0.316	0.338	8.4015
12	0.118	0.343	0.102	0.071	0.314	0.341	0.209	0.189	0.167	-.283	0.255	0.446	0.305	2.2006
13	0.042	-.271	-.263	-.117	-.067	-.139	-.165	-.155	-.239	0.344	-.094	-.189	-.080	3.5965
14	-.401	0.103	0.337	0.142	0.042	0.161	0.129	0.126	0.242	-.379	-.184	0.183	-.111	40.2887
15	-.081	0.210	0.181	0.345	0.272	0.353	0.386	0.384	0.313	-.245	-.098	0.197	0.009	8.2602
16	0.093	0.201	0.061	0.019	-.251	-.205	-.187	-.182	0.195	0.248	0.005	0.009	0.481	8.8185
17	0.162	0.327	0.127	0.416	0.413	0.496	0.492	0.474	0.362	-.300	0.061	0.562	0.280	18.9442
18		0.371	-.332	-.031	0.401	0.240	0.093	0.074	-.006	-.143	0.320	0.111	0.030	2.8404
19	0.371		-.108	0.025	0.306	0.317	0.079	0.071	0.433	-.437	0.231	0.332	0.183	9.4215
20	-.332	-.108		0.493	-.270	-.074	0.199	0.211	0.539	0.028	-.114	0.184	0.145	9.7101
21	-.031	0.025	0.493		0.207	0.312	0.445	0.444	0.375	0.172	-.019	0.303	0.337	10.3247
22	0.401	0.306	-.270	0.207		0.909	0.464	0.433	-.079	-.010	0.182	0.068	-.028	2.0782
23	0.240	0.317	-.074	0.312	0.909		0.572	0.547	0.143	-.108	0.123	0.150	0.035	18.2230
24	0.093	0.079	0.199	0.445	0.464	0.572		0.999	0.259	-.014	0.122	0.295	0.224	441.2359
25	0.074	0.071	0.211	0.444	0.433	0.547	0.999		0.261	-.007	0.116	0.294	0.227	0.7360
26	-.006	0.433	0.539	0.375	-.079	0.143	0.259	0.261		-.242	-.004	0.310	0.241	16.8944
27	-.143	-.437	0.028	0.172	-.010	-.108	-.014	-.007	-.242		-.043	-.188	0.337	8.4753
28	0.320	0.231	-.114	-.019	0.182	0.123	0.122	0.116	-.004	-.043		0.174	0.126	5.1180
29	0.111	0.332	0.184	0.303	0.068	0.150	0.295	0.294	0.310	-.188	0.174		0.752	6.7218
30	0.030	0.183	0.145	0.337	-.028	0.035	0.224	0.227	0.241	0.337	0.126	0.752		3.8205

APPENDIX – WITHIN CORRELATION MATRIX : DATA B

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		0.266	0.337	0.322	0.349	0.365	0.353	0.796	0.569	0.743	0.074	0.330	0.019	-.104	-.011	0.019	0.486
2	0.266		0.114	0.186	0.300	0.327	0.310	0.285	0.097	0.189	0.013	0.197	-.136	-.008	-.012	0.122	0.364
3	0.337	0.114		0.796	0.688	0.682	0.684	0.320	0.208	0.320	0.072	0.315	0.002	-.039	0.008	-.026	0.328
4	0.322	0.186	0.796		0.679	0.651	0.651	0.285	0.145	0.317	0.020	0.421	-.076	-.003	0.005	0.037	0.393
5	0.349	0.300	0.688	0.679		0.940	0.933	0.316	0.133	0.335	0.114	0.278	-.032	0.107	0.055	0.047	0.338
6	0.365	0.327	0.682	0.651	0.940		0.994	0.341	0.147	0.320	0.110	0.259	-.014	0.122	0.088	0.052	0.330
7	0.353	0.310	0.684	0.651	0.933	0.994		0.329	0.148	0.321	0.121	0.266	-.009	0.122	0.084	0.056	0.328
8	0.796	0.285	0.320	0.285	0.316	0.341	0.329		0.617	0.596	-.096	0.291	0.022	-.049	0.036	0.005	0.457
9	0.569	0.097	0.208	0.145	0.133	0.147	0.148	0.617		0.491	-.014	0.243	0.036	-.005	0.022	0.056	0.301
10	0.743	0.189	0.320	0.317	0.335	0.320	0.321	0.596	0.491		0.506	0.275	0.170	-.026	-.042	-.034	0.383
11	0.074	0.013	0.072	0.020	0.114	0.110	0.121	-.096	-.014	0.506		-.024	0.257	0.032	-.073	-.078	0.011
12	0.330	0.197	0.315	0.421	0.278	0.259	0.266	0.291	0.243	0.275	-.024		-.623	0.135	0.070	0.078	0.211
13	0.019	-.136	0.002	-.076	-.032	-.014	-.009	0.022	0.036	0.170	0.257	-.623		-.109	-.069	-.139	0.078
14	-.104	-.008	-.039	-.003	0.107	0.122	0.122	-.049	-.005	-.026	0.032	0.135	-.109		0.611	0.051	0.092
15	-.011	-.012	0.008	0.005	0.055	0.088	0.084	0.036	0.022	-.042	-.073	0.070	-.069	0.611		0.098	0.094
16	0.019	0.122	-.026	0.037	0.047	0.052	0.056	0.005	0.056	-.034	-.078	0.078	-.139	0.051	0.098		0.112
17	0.486	0.364	0.328	0.393	0.338	0.330	0.328	0.457	0.301	0.383	0.011	0.211	0.078	0.092	0.094	0.112	
18	-.108	0.022	-.009	-.086	0.021	0.050	0.062	-.159	-.132	-.074	0.057	-.061	0.122	0.208	0.062	-.064	-.086
19	-.095	-.053	0.003	-.078	0.016	0.059	0.073	-.181	-.206	-.031	0.125	-.021	0.084	0.209	0.070	0.012	-.084
20	0.130	0.612	0.123	0.187	0.251	0.281	0.268	0.221	0.069	0.084	-.036	0.033	-.067	-.161	-.106	0.041	0.134
21	0.253	0.262	0.216	0.183	0.221	0.245	0.240	0.200	0.188	0.278	0.089	0.040	0.004	-.080	0.040	0.050	0.127
22	0.327	0.035	0.493	0.569	0.351	0.338	0.337	0.203	0.114	0.329	0.143	0.230	0.038	-.155	0.016	-.049	0.250
23	0.417	0.290	0.503	0.522	0.370	0.398	0.388	0.355	0.218	0.393	0.064	0.242	0.002	-.081	0.037	0.094	0.326
24	0.392	0.285	0.478	0.559	0.385	0.440	0.432	0.313	0.168	0.356	0.061	0.226	0.032	-.050	0.071	0.099	0.343
25	0.393	0.284	0.457	0.527	0.359	0.423	0.415	0.314	0.170	0.355	0.057	0.217	0.032	-.052	0.072	0.099	0.333
26	0.188	0.749	0.004	0.093	0.176	0.201	0.189	0.182	0.078	0.133	0.003	0.146	-.090	0.028	0.004	0.111	0.301
27	-.053	-.049	-.151	-.100	-.234	-.196	-.198	-.039	-.074	-.138	-.039	-.021	0.001	-.033	-.015	0.147	0.007
28	0.024	-.028	0.019	-.037	0.023	-.016	-.029	0.068	0.035	-.030	-.023	0.059	0.047	-.062	-.029	0.044	-.060
29	0.976	0.261	0.351	0.317	0.368	0.381	0.370	0.808	0.568	0.737	0.036	0.328	0.020	-.053	-.013	0.013	0.510
30	0.967	0.230	0.321	0.303	0.330	0.339	0.328	0.753	0.556	0.692	0.043	0.326	-.007	-.074	0.012	0.059	0.461

	18	19	20	21	22	23	24	25	26	27	28	29	30	SD
1	-.108	-.095	0.130	0.253	0.327	0.417	0.392	0.393	0.188	-.053	0.024	0.976	0.967	3.1665
2	0.022	-.053	0.612	0.262	0.035	0.290	0.285	0.284	0.749	-.049	-.028	0.261	0.230	10.9531
3	-.009	0.003	0.123	0.216	0.493	0.503	0.478	0.457	0.004	-.151	0.019	0.351	0.321	0.9759
4	-.086	-.078	0.187	0.183	0.569	0.522	0.559	0.527	0.093	-.100	-.037	0.317	0.303	1.3966
5	0.021	0.016	0.251	0.221	0.351	0.370	0.385	0.359	0.176	-.234	0.023	0.368	0.330	22.7801
6	0.050	0.059	0.281	0.245	0.338	0.398	0.440	0.423	0.201	-.196	-.016	0.381	0.339	502.2818
7	0.062	0.073	0.268	0.240	0.337	0.388	0.432	0.415	0.189	-.198	-.029	0.370	0.328	0.8420
8	-.169	-.181	0.221	0.200	0.203	0.355	0.313	0.314	0.182	-.089	0.068	0.808	0.753	17.1096
9	-.132	-.206	0.069	0.188	0.114	0.218	0.168	0.170	0.078	-.074	0.035	0.568	0.556	3.1051
10	-.074	-.031	0.084	0.278	0.329	0.393	0.356	0.355	0.133	-.133	-.030	0.737	0.692	3.4687
11	0.057	0.125	-.036	0.089	0.143	0.064	0.061	0.057	0.003	-.039	-.023	0.086	0.043	2.7652
12	-.061	-.021	0.033	0.040	0.230	0.242	0.226	0.217	0.146	-.021	0.059	0.328	0.326	1.2764
13	0.122	0.084	-.067	0.004	0.038	0.002	0.032	0.032	-.090	0.001	0.047	0.020	-.007	2.3709
14	0.208	0.209	-.161	-.080	-.155	-.081	-.050	-.052	0.028	-.033	-.062	-.053	-.074	0.8613
15	0.062	0.070	-.106	0.040	0.016	0.037	0.071	0.072	0.004	-.015	-.029	-.013	0.012	0.5488
16	-.064	0.012	0.041	0.050	-.049	0.094	0.099	0.099	0.111	0.147	0.044	0.013	0.059	1.2649
17	-.086	-.084	0.134	0.127	0.250	0.326	0.343	0.333	0.301	0.007	-.060	0.510	0.461	13.2039
18		0.761	-.092	0.047	-.065	0.004	0.038	0.047	0.057	0.097	-.188	-.127	-.143	1.0795
19	0.761		-.166	-.065	-.009	-.003	0.022	0.030	-.020	0.053	-.037	-.101	-.125	2.5953
20	-.092	-.166		0.444	0.215	0.344	0.372	0.370	0.554	-.064	0.005	0.119	0.089	6.7397
21	0.047	-.065	0.444		0.399	0.436	0.437	0.446	0.230	0.003	-.126	0.224	0.208	8.6306
22	-.065	-.009	0.215	0.399		0.735	0.759	0.744	0.027	-.023	0.022	0.301	0.311	1.0045
23	0.004	-.003	0.344	0.436	0.735		0.957	0.960	0.240	-.086	0.018	0.417	0.395	10.7670
24	0.038	0.022	0.372	0.437	0.759	0.957		0.997	0.261	-.067	0.021	0.384	0.367	266.1808
25	0.047	0.030	0.370	0.446	0.744	0.960	0.997		0.261	-.070	0.024	0.386	0.368	0.4432
26	0.057	-.020	0.554	0.230	0.027	0.240	0.261	0.261		-.151	0.001	0.190	0.154	10.2145
27	0.097	0.053	-.064	0.003	-.023	-.086	-.067	-.070	-.151		-.141	-.155	-.032	1.3194
28	-.188	-.037	0.005	-.126	0.022	0.018	0.021	0.024	0.001	-.141		0.032	0.009	0.5385
29	-.127	-.101	0.119	0.224	0.301	0.417	0.384	0.386	0.190	-.155	0.032		0.949	4.9817
30	-.143	-.125	0.089	0.208	0.311	0.395	0.367	0.368	0.154	-.032	0.009	0.949		2.2927

APPENDIX

THE VARIETAL MEANS : DATA B

VARIABLE	VARIETIES 1	2	3	4	5	6	7	8	9
1	11.100	15.767	13.167	13.667	16.500	14.500	12.167	12.733	10.500
2	56.267	71.933	79.600	82.667	70.933	65.533	62.333	79.067	87.400
3	5.067	6.067	5.333	10.800	4.733	5.733	4.667	5.600	6.000
4	5.267	6.467	5.467	15.533	5.600	6.267	4.733	5.933	6.400
5	76.867	92.333	93.867	229.800	89.933	59.067	63.133	95.400	122.800
6	1552.333	2114.667	1881.000	3415.000	1800.667	2156.667	1539.000	1936.667	2552.000
7	2.587	3.524	3.135	5.692	3.001	3.594	2.569	3.233	4.253
8	88.667	149.000	91.000	106.000	78.333	113.667	102.000	88.000	86.667
9	59.333	51.333	31.000	48.667	30.000	51.333	51.333	61.667	55.000
10	15.267	16.800	10.267	16.933	17.400	12.133	10.467	11.467	12.200
11	17.400	11.367	11.133	15.967	22.367	9.367	8.800	13.333	14.200
12	2.867	3.800	5.533	7.467	3.667	4.667	2.533	3.867	4.267
13	7.117	4.827	1.963	2.347	4.800	2.800	4 153	3.210	3.107
14	71.500	91.533	109.533	105.333	93.000	143.000	163.633	138.567	143 633
15	30.667	37.600	39.800	40.367	36.700	39.500	42.000	39.100	45.100
16	73.400	74.633	77.067	68.400	74.867	65.233	66.367	64.300	67.767
17	39.400	48.467	52.800	86.267	51.267	49.667	39 800	58.200	52 400
18	27.000	29.567	27.333	33.000	26.333	24.667	26.000	26.000	27.667
19	96.333	102.333	110.667	111.333	105.667	100.333	99.667	101.333	112.333
20	36.000	51.000	47.867	38 700	43.200	51.800	44.800	49.933	51.367
21	30.000	41.467	30.200	40.000	36 333	42.200	36.200	37.467	40.200
22	5.067	6.133	5 333	11.733	5.467	6.133	5.333	5.400	5.667
23	47.533	56.067	49.800	99.433	50.867	50.200	49.267	57.267	60.533
24	959.000	1342.333	997.333	1287.667	1018.333	1368.000	1206.000	1162.667	1326.000
25	1.598	2.238	1.663	1.979	1.698	2.280	1.980	1.937	2.210
26	50.567	67.400	68.733	65.333	67.733	61.400	57.800	74.333	82.133
27	64.300	65.233	59.467	56.467	64.200	66.567	62.367	52.600	46.000
28	46.567	46.267	53.933	50.200	50.000	45.833	42.767	49.600	44.867
29	17.333	24.133	22.133	24.267	25.667	21.800	19.467	24.200	21.467
30	8.133	11.800	10.167	9.367	12.333	9.467	8.067	8.233	7,133

VARIABLE	VARIETIES								
	10	11	12	13	14	15	16	17	18
1	10.500	11.933	11.733	18.033	10.567	17.133	11.333	11.500	13.033
2	71.300	66.933	68.067	99.933	65.467	64.000	76.800	79.000	89.600
3	4.533	5.200	6.933	5.200	6.667	6.267	4.933	5.533	5.200
4	4.800	5.600	9.800	7.200	6.867	6.467	5.000	5.733	6.467
5	73.267	93.867	140.733	135.467	93.600	109.200	82.600	96.200	120.733
6	1990.667	2004.333	2292.667	3547.667	2396.667	1814.333	2019.000	2392.333	2491.333
7	3.318	3.340	3.821	5.913	3.995	3.024	3.365	3.987	4.152
8	91.667	127.667	96.667	113.000	67.333	96.667	105.667	72.000	92.333
9	56.000	35.667	39.333	56.333	36.667	39.333	38.333	44.000	55.667
10	11.133	16.733	15.400	17.333	11.533	24.533	14.467	11.333	15.267
11	12.000	18.173	15.800	14.890	22.167	25.667	13.503	15.787	16.560
12	1.733	3.400	3.867	3.667	3.400	3.267	4.467	3.667	4.133
13	6.463	5.227	3.950	5.697	4.480	7.473	3.327	3.363	3.653
14	72.267	93.133	102.667	110.733	85.700	60.633	75.867	133.500	92.500
15	33.367	36.133	40.900	42.600	35.467	25.533	32.967	34.867	47.767
16	71.333	77.867	68.467	70.633	74.067	74.067	74.733	71.300	75.500
17	39.667	41.067	39.067	53.400	23.733	45.667	41.467	43.133	45.467
18	29.667	27.000	30.667	29.000	27.333	28.333	27.667	26.000	28.000
19	95.333	102.000	112.333	102.333	94.667	107.333	96.333	97.000	109.000
20	50.267	49.600	36.067	53.000	49.400	37.067	48.933	53.933	50.400
21	34.333	31.667	31.433	43.333	38.333	35.200	36.333	25.333	36.800
22	4.400	5.067	9.067	5.400	6.267	5.733	4.933	5.400	5.000
23	46.333	48.200	79.600	52.933	57.600	56.933	47.133	56.333	46.933
34	1258.000	1059.333	1300.667	1385.333	1460.000	944.333	1155.333	1400.667	964.000
25	2.099	1.766	2.168	2.309	2.433	1.574	1.925	2.335	1.607
26	67.800	52.867	59.400	83.733	64.200	56.467	57.733	71.933	87.000
27	67.367	62.267	63.500	61.433	65.600	64.433	61.367	57.633	64.367
28	48.200	50.167	54.300	44.467	51.667	52.233	48.667	42.533	45.333
29	15.600	19.267	18.533	29.400	16.067	26.533	18.467	19.867	20.200
30	7.567	9.300	8.033	12.733	7.800	12.700	8.533	8.200	9.833

VARIABLE	VARIETIES								
	19	20	21	22	23	24	25	26	27
1	12.600	16.400	15.633	14.033	11.533	13.600	14.100	16.267	12.700
2	63.667	78.867	61.467	83.267	80.200	68.600	66.867	68.133	63.667
3	9.733	7.667	6.067	8.067	6.333	6.600	6.067	7.200	5.400
4	10.200	7.800	6.267	11.667	6.933	6.733	7.267	8.000	6.867
5	131.267	135.800	113.067	167.667	109.933	77.133	90.400	101.600	70.533
6	2332.333	2356.000	2619.333	4421.000	2905.333	1939.000	2260.667	2163.667	1402.000
7	3.887	3.927	4.365	7.368	4.842	3.232	3.768	3.606	2.337
8	88.333	66.667	92.667	117.000	139.333	108.000	172.000	107.333	97.000
9	31.000	45.333	60.667	53.333	55.000	55.000	52.000	29.667	32.333
10	16.667	15.600	14.733	15.000	14.000	14.600	18.133	18.900	14.533
11	19.010	23.610	16.783	12.767	10.033	13.467	10.613	17.943	16.697
12	1.933	6.400	4.933	5.333	2.467	5.333	3.067	4.200	2.667
13	11.340	2.497	3.083	3.050	5.907	3.180	6.890	4.970	7.280
14	88.367	116.267	104.100	117.300	82.333	100.967	75.033	80.900	86.200
15	47.333	43.900	39.367	47.600	40.500	34.533	36.933	32.167	37.533
16	64.900	74.733	72.733	67.500	69.567	74.700	67.667	71.067	75.067
17	50.400	51.267	52.267	74.600	54.467	36.267	54.733	39.600	37.867
18	28.000	27.000	28.333	29.333	27.667	28.667	27.667	28.333	27.667
19	99.333	103.000	104.333	110.000	106.667	95.667	97.000	100.333	104.000
20	47.267	48.467	47.533	47.400	46.933	51.000	50.067	50.467	44.933
21	43.200	40.533	39.333	52.867	38.467	41.600	47.733	41.200	35.167
22	9.333	6.867	5.733	8.267	5.733	5.533	6.533	6.667	5.133
23	84.400	69.067	54.667	85.400	54.667	48.000	56.800	66.200	47.133
24	1496.667	1201.667	1318.667	2249.333	1430.667	1206.000	1469.333	1404.667	936.000
25	2.494	2.003	2.198	3.749	2.384	1.980	2.449	2.341	1.560
26	52.567	67.400	60.400	76.067	69.000	58.733	57.867	57.667	61.133
27	71.333	64.267	66.367	55.700	60.433	68.333	67.100	68.500	54.500
28	43.967	47.067	49.567	53.100	48.200	51.633	43.200	47.667	44.233
29	18.867	25.467	23.533	23.933	19.133	19.933	21.067	23.733	19.800
30	8.200	12.267	11.400	9.467	8.033	10.133	9.533	11.567	9.567

VARIABLE	VARIETIES								
	28	29	30	31	32	33	34	35	36
1	15.467	15.800	14.667	11.800	13.133	14.867	17.400	13.000	13.567
2	81.000	80.667	77.200	77.200	73.600	67.933	78.800	75.333	60.200
3	8.867	5.533	5.467	5.000	5.533	5.933	7.133	5.867	5.600
4	10.200	5.867	5.800	5.200	5.600	6.400	7.867	6.000	6.467
5	165.800	110.933	86.667	84.733	95.800	105.733	109.867	97.733	105.600
6	4313.667	2704.333	1922.667	1842.000	2232.667	2229.333	2849.667	2189.000	2031.667
7	7.189	4.507	3.205	3.070	3.721	3.716	4.750	3.558	3.387
8	106.333	80.667	97.667	78.333	105.667	106.333	118.000	80.000	79.333
9	40.667	46.667	56.000	39.333	49.667	50.667	40.333	29.667	62.667
10	14.400	16.800	16.000	10.867	16.800	13.400	18.267	13.267	21.300
11	13.747	20.970	16.313	13.883	15.940	10.547	15.500	16.520	26.043
12	4.067	4.133	5.000	2.467	3.667	4.000	4.133	4.867	2.333
13	3.747	4.100	3.367	4.403	4.563	3.767	4.780	3.693	10.347
14	117.733	83.267	110.633	105.967	92.800	97.833	99.800	127.467	78.633
15	48.867	39.900	41.933	41.400	34.200	39.400	44.833	42.633	33.433
16	73.367	77.867	78.967	77.333	76.033	75.233	77.267	73.100	80.733
17	56.667	43.000	45.000	43.000	44.867	48.867	51.533	61.600	42.933
18	27.000	28.333	27.000	28.000	28.000	29.000	28.333	29.667	30.333
19	107.000	100.667	95.667	106.667	103.000	102.000	104.333	104.667	110.000
20	50.533	49.800	52.533	49.133	53.400	53.600	49.467	50.333	32.467
21	47.200	40.600	39.267	42.400	41.933	50.733	43.467	41.467	25.600
22	8.133	5.267	.5.333	5.133	5.200	5.867	5.867	5.867	5.867
23	75.733	56.333	57.333	47.200	49.733	55.000	60.400	51.000	51.600
24	1962.000	1373.333	1272.000	1026.667	1159.000	1159.333	1575.667	1133.667	993.000
25	3.270	2.289	2.120	1.703	1.932	1.932	2.596	1.889	1.555
26	69.133	68.467	69.467	71.733	66.533	69.267	72.200	68.867	58.267
27	61.867	59.167	64.833	66.367	60.400	69.400	62.733	59.967	60.133
28	48.367	51.267	47.300	46.567	45.333	48.467	52.267	53.000	46.800
29	25.067	25.733	22.600	17.800	21.800	21.400	27.800	21.733	22.933
30	11.367	12.333	11.567	9.100	10.000	11.200	13.467	9.533	11.233

VARIABLE	VARIETIES								
	37	38	39	40	41	42	43	44	45
1	14.500	10.100	13.933	13.300	17.167	12.200	14.633	12.967	15.667
2	79.267	78.067	73.467	88.333	71.267	70.667	94.933	53.467	93.133
3	5.400	5.667	6.467	6.333	6.800	4.800	5.067	5.400	5.567
4	5.800	5.867	6.800	7.600	7.133	5.267	5.200	5.467	5.733
5	81.800	103.133	94.600	97.667	107.467	73.000	99.867	79.067	105.067
6	1520.667	1962.667	1942.000	2024.333	3527.000	1750.333	1988.667	1670.000	2333.667
7	2.534	3.277	3.237	3.374	5.879	2.918	3.314	3.117	3.898
8	84.333	109.000	119.667	80.333	74.333	107.333	132.333	127.667	70.667
9	58.333	59.667	50.000	39.000	36.667	39.333	61.333	65.333	57.333
10	10.467	9.933	12.400	18.000	14.600	11.267	13.133	10.600	21.467
11	12.270	8.903	10.660	22.277	18.490	11.463	10.117	8.357	30.587
12	3.333	1.933	2.400	3.600	2.600	1.667	2.600	3.733	2.733
13	5.473	5.363	3.467	5.067	5.313	6.947	5.307	3.407	8.117
14	158.333	125.267	93.633	99.233	119.000	67.000	117.000	132.067	89.267
15	42.267	41.367	34.567	42.100	49.733	32.867	46.333	43.267	39.400
16	72.800	66.767	78.567	75.200	74.533	79.400	70.733	68.967	75.133
17	55.533	56.667	48.000	54.733	63.533	39.467	55.467	52.667	57.067
18	24.000	25.333	28.000	29.333	28.667	29.333	24.333	25.000	28.333
19	96.000	97.333	100.000	112.333	97.000	96.667	99.667	98.667	104.000
20	57.800	55.567	48.767	52.067	44.533	50.500	60.533	39.800	47.667
21	50.667	48.567	41.067	43.600	43.867	42.233	42.600	39.633	42.667
22	5.467	5.467	6.267	5.733	6.533	5.133	4.600	5.200	5.133
23	59.467	62.600	56.067	51.800	58.133	49.000	56.333	49.000	52.933
24	1105.667	1193.333	1144.567	1071.333	1837.333	1177.000	1144.667	1033.667	1179.000
25	1.842	1.988	1.908	1.785	3.062	1.962	1.908	1.722	1.966
26	70.733	68.067	62.133	81.067	63.933	65.667	81.067	41.267	79.000
27	69.267	59.267	71.100	57.200	67.767	70.633	62.700	59.167	60.600
28	48.567	44.233	42.900	47.733	46.900	47.633	46.100	43.100	46.633
29	21.000	17.067	19.733	23.333	25.400	17.267	23.333	21.933	25.867
30	10.567	6.767	10.967	10.000	12.800	9.700	10.367	8.967	11.667

VARIABLE	VARIETIES								
	46	47	48	49	50	51	52	53	54
1	15.300	19.800	- 21.300	18.467	16.533	12.833	20.033	18.067	12.633
2	71.467	72.000	91.867	79.800	80.000	67.733	68.467	72.000	64.867
3	5.067	7.200	5.867	6.067	5.800	6.133	5.400	6.200	4.867
4	5.267	7.267	7.267	6.267	6.400	6.467	5.733	6.667	5.267
5	81.933	129.233	125.933	84.533	97.200	95.400	72.400	108.267	74.067
6	1802.000	3137.333	3450.667	2533.000	2456.000	2025.667	1463.333	2605.667	1826.000
7	3.003	5.262	5.755	4.222	4.089	3.376	2.607	4.443	3.044
8	89.667	113.667	133.000	126.000	96.333	93.000	69.333	103.667	104.333
9	54.000	42.333	57.667	54.333	53.000	51.667	35.000	56.000	58.000
10	15.667	18.267	20.800	14.067	16.533	10.600	15.867	21.467	13.267
11	17.323	15.883	15.370	11.280	17.200	10.957	23.373	19.707	12.693
12	5.400	7.333	4.533	5.133	3.867	3.400	2.400	4.267	3.000
13	2.817	2.613	4.560	2.807	4.977	2.330	7.370	5.167	10.923
14	151.467	108.333	90.400	125.233	94.233	101.500	97.300	93.200	84.000
15	38.367	42.133	36.167	40.733	39.067	40.867	36.800	41.567	36.367
16	70.700	70.433	81.000	61.133	76.067	74.533	75.167	73.467	73.233
17	43.333	56.000	70.200	75.467	64.267	43.467	36.667	69.533	45.467
18	28.000	25.667	26.000	28.333	29.000	28.000	28.000	30.333	25.000
19	105.667	104.000	105.000	101.000	111.000	109.667	103.667	99.333	95.667
20	50.600	52.400	49.533	53.200	52.067	43.933	50.067	50.933	48.933
21	34.000	43.267	46.133	37.200	41 400	30.733	48.600	44.867	30.867
22	5.000	5.800	6.533	5.667	5.600	5.733	5.200	5.400	4.933
23	49.933	57.333	68.000	51.667	51.667	54.933	44.533	55.600	46.067
24	1097.000	1396.333	1861.000	1543.333	1305.667	1165.333	901.333	1347.667	1139.667
25	1.828	2.327	3.101	2.570	2.176	1.939	1.502	2.246	1.898
26	56.933	66.733	78.400	60.133	69 067	59.667	65.733	65.333	53.933
27	60.000	64.667	75.500	56.367	62.067	61.533	67.200	59.433	59.367
28	46.067	47.767	47.933	51 100	48.000	46.333	51.467	45.400	48.933
29	25.533	30.667	28.200	32.867	27.333	20.800	29.933	30.400	18.200
30	10.567	13.967	19.967	11.300	12.567	9.600	15.067	13.267	9.233

VARIABLE	VARIETIES 55	56	57	58	59	60	61	62
1	14.533	16.433	15.700	13.567	13.367	13.600	14.267	16.133
2	94.800	103.333	83.067	82.867	76.000	69.533	61.200	65.467
3	5.800	6.067	6.200	6.667	5.867	5.200	5.867	5.533
4	7.000	8.333	6.467	7.667	6.133	5.467	6.200	5.667
5	113.933	138.733	118.200	168.600	104.067	82.133	75.533	98.200
6	3295.667	3237.000	2989.667	4013.667	2501.000	1890.333	1891.000	2490.333
7	5.492	5.395	4.893	6.689	4.168	3.151	3.151	4.150
8	99.667	99.667	124.667	123.333	74.000	67.333	136.333	71.667
9	40.333	57.667	41.667	50.333	31.000	53.667	48.667	53.000
10	17.733	16.267	17.867	16.400	14.533	14.467	12.933	16.600
11	17.780	19.980	14.213	13.623	19.683	21.397	9.443	23.387
12	4.067	4.000	4.533	3.533	3.467	1.800	1.533	3.467
13	4.357	4.343	3.967	4.860	4.187	8.020	8.870	4.740
14	69.000	146.067	92.267	104.467	93.033	78.600	84.700	97.867
15	38.100	38.000	39.133	45.067	36.800	39.567	36.267	42.667
16	76.867	69.767	78.100	72.467	77.433	57.867	56.333	73.033
17	57.467	71.200	47.667	57.133	45.400	53.267	49.667	49.333
18	28.333	27.667	28.667	29.000	29.667	29.000	28.667	29.000
19	106.000	114.000	108.333	111.333	109.000	95.667	96.000	101.333
20	49.200	60.800	59.333	44.800	50.800	37.867	48.333	44.933
21	50.400	47.067	39.400	39.467	40.733	31.667	38.600	38.667
22	5.667	6.533	5.333	6.133	5.867	5.200	6.667	5.333
23	52.400	71.933	53.600	60.267	53.000	46.600	52.867	49.000
24	1515.333	1672.333	1351.000	1444.000	1271.667	1261.667	1321.667	1245.000
25	2.522	2.787	2.252	2.406	2.119	2.103	2.202	2.075
26	83.733	98.933	71 800	72.400	56.667	59.267	51.467	61.267
27	64.867	61.467	62.933	57.233	60.167	63.400	66.800	65.400
28	48.300	48.933	51.233	48.867	50.167	50.033	52.767	49.100
29	22.400	29.800	25.067	23.800	22.200	21.467	21.400	22.933
30	11.167	11.467	12.267	9.867	10.333	7.867	8.100	11.767

APPENDIX - GENOTYPIC CORRELATION MATRIX : DATA B

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1		0.195	0.068	0.015	0.090	0.347	0.365	-.262	-.134	0.456	0.442	0.357	-.158	0.014	0.151	0.207	0.319
2	0.195		0.094	0.214	0.518	0.603	0.597	-.065	0.124	0.120	0.082	0.237	-.360	0.248	0.411	0.156	0.609
3	0.068	0.094		0.954	0.807	0.556	0.556	0.025	-.265	0.216	0.088	0.452	-.166	0.019	0.439	-.195	0.491
4	0.015	0.214	0.954		0.888	0.610	0.611	0.097	-.176	0.242	0.067	0.415	-.151	0.016	0.369	-.183	0.593
5	0.090	0.518	0.807	0.888		0.752	0.752	0.008	-.034	0.335	0.152	0.544	-.324	0.049	0.465	-.014	0.726
6	0.347	0.603	0.556	0.610	0.752		1.000	0.159	0.007	0.287	0.010	0.438	-.372	0.061	0.506	0.007	0.746
7	0.365	0.597	0.556	0.611	0.752	1.000		0.167	0.018	0.283	0.005	0.436	-.377	0.067	0.514	0.002	0.753
8	-.262	-.065	0.025	0.097	0.008	0.159	0.167		0.221	-.126	-.743	-.033	-.059	-.104	-.059	-.188	0.152
9	-.134	0.124	-.265	-.176	-.034	0.007	0.018	0.221		-.182	-.267	-.093	0.011	0.254	0.071	-.238	0.322
10	0.456	0.120	0.216	0.242	0.335	0.287	0.283	-.126	-.182		0.739	0.172	0.342	-.577	-.242	0.366	0.076
11	0.442	0.082	0.088	0.067	0.152	0.010	0.005	-.743	-.267	0.739		0.048	0.322	-.316	-.130	0.322	-.119
12	0.357	0.237	0.452	0.415	0.544	0.438	0.436	-.033	-.093	0.172	0.048		-.754	0.319	0.251	0.100	0.483
13	-.158	-.360	-.166	-.151	-.324	-.372	-.377	-.059	0.011	0.342	0.322	-.754		-.650	-.335	-.105	-.433
14	0.014	0.248	0.019	0.016	0.049	0.061	0.067	-.104	0.254	-.577	-.316	0.319	-.650		0.492	-.318	0.386
15	0.151	0.411	0.439	0.369	0.465	0.506	0.514	-.059	0.071	-.242	-.130	0.251	-.335	0.492		-.188	0.564
16	0.207	0.156	-.195	-.183	-.014	0.007	0.002	-.188	-.238	0.366	0.322	0.100	-.105	-.318	-.188		-.388
17	0.319	0.609	0.491	0.593	0.726	0.746	0.753	0.152	0.322	0.076	-.119	0.483	-.433	0.386	0.564	-.388	
18	0.104	0.032	0.451	0.554	0.485	0.312	0.302	-.082	-.214	0.535	0.335	0.175	0.016	-.435	-.090	0.105	0.278
19	0.233	0.546	0.330	0.499	0.653	0.451	0.446	-.052	-.138	0.391	0.220	0.442	-.396	0.106	0.218	0.211	0.498
20	0.200	0.480	-.266	-.376	-.275	0.048	0.040	0.216	0.051	-.421	-.410	0.151	-.429	0.472	0.259	0.080	0.120
21	0.593	0.568	0.438	0.451	0.347	0.615	0.633	0.316	-.033	-.097	-.256	0.114	-.288	0.262	0.625	0.023	0.868
22	-.127	0.019	1.015	1.037	0.847	0.507	0.507	0.074	-.239	0.077	-.009	0.350	-.121	0.050	0.311	-.286	0.524
23	-.188	0.207	1.007	1.060	0.999	0.631	0.633	0.026	-.103	0.034	-.002	0.392	-.230	0.201	0.437	-.267	0.625
24	0.206	0.354	0.529	0.513	0.542	0.984	0.986	0.265	0.010	-.026	-.190	0.199	-.296	0.163	0.482	-.247	0.608
25	0.208	0.349	0.498	0.481	0.516	0.977	0.978	0.260	0.009	-.030	-.185	0.174	-.280	0.158	0.478	-.241	0.584
26	0.186	0.985	-.032	0.128	0.429	0.533	0.522	-.179	0.158	0.093	0.151	0.178	-.340	0.304	0.393	0.235	0.412
27	0.378	-.372	-.061	-.126	-.315	-.213	-.217	0.136	-.153	0.106	-.032	-.349	0.463	-.383	-.248	0.250	-.425
28	0.236	0.026	0.151	0.210	0.195	0.176	0.167	-.139	-.325	0.158	0.206	0.310	-.131	-.185	-.099	0.004	0.091
29	0.792	0.488	0.143	0.140	0.307	0.480	0.501	-.341	-.029	0.410	0.465	0.558	-.394	0.274	0.295	0.012	0.620
30	0.905	0.273	-.025	-.038	0.099	0.301	0.312	-.195	-.149	0.559	0.436	0.293	-.129	-.137	0.010	0.601	0.152

	18	19	20	21	22	23	24	25	26	27	28	29	30	SD
1	0.104	0.233	0.200	0.593	-.127	-.188	0.206	0.208	0.186	0.378	0.236	0.792	0.905	1.6499
2	0.032	0.546	0.480	0.568	0.019	0.207	0.354	0.349	0.985	-.372	0.026	0.488	0.273	8.4007
3	0.451	0.330	-.266	0.438	1.015	1.007	0.529	0.498	-.032	-.061	0.151	0.143	-.025	0.9841
4	0.554	0.499	-.376	0.451	1.037	1.060	0.513	0.481	0.128	-.126	0.210	0.140	-.038	1.5597
5	0.485	0.653	-.275	0.347	0.847	0.999	0.542	0.516	0.429	-.315	0.195	0.307	0.099	25.8559
6	0.312	0.451	0.048	0.615	0.507	0.631	0.984	0.977	0.533	-.213	0.176	0.480	0.301	613.9498
7	0.302	0.446	0.040	0.633	0.507	0.633	0.986	0.978	0.522	-.217	0.167	0.501	0.312	1.0130
8	-.082	-.052	0.216	0.316	0.074	0.026	0.265	0.260	-.179	0.136	-.139	-.341	-.195	19.9697
9	-.214	-.138	0.051	-.033	-.239	-.103	0.010	0.009	0.158	-.153	-.325	-.029	-.149	9.7146
10	0.535	0.391	-.421	-.097	0.077	0.034	-.026	-.030	0.093	0.106	0.158	0.410	0.559	2.4604
11	0.335	0.220	-.410	-.256	-.009	-.002	-.190	-.185	0.151	-.032	0.206	0.465	0.436	4.5803
12	0.175	0.442	0.151	0.114	0.350	0.392	0.199	0.174	0.178	-.349	0.310	0.558	0.293	1.0349
13	0.016	-.395	-.429	-.288	-.121	-.230	-.296	-.280	-.340	0.463	-.131	-.394	-.129	1.5614
14	-.435	0.106	0.472	0.262	0.050	0.201	0.163	0.158	0.304	-.383	-.185	0.274	-.137	23.2554
15	-.090	0.218	0.259	0.625	0.311	0.437	0.482	0.478	0.393	-.248	-.099	0.395	0.010	4.7585
16	0.105	0.211	0.080	0.023	-.286	-.267	-.247	-.241	0.235	0.250	0.004	0.012	0.601	5.0387
17	0.278	0.498	0.120	0.868	0.524	0.625	0.608	0.584	0.412	-.425	0.091	0.620	0.152	7.8430
18		0.327	-.462	-.090	0.510	0.320	0.114	0.085	-.026	-.162	0.356	0.236	0.084	1.5168
19	0.327		-.111	0.076	0.365	0.410	0.098	0.086	0.570	-.463	0.242	0.547	0.265	5.2290
20	-.462	-.111		0.595	-.543	-.370	0.076	0.098	0.535	0.049	-.160	0.254	0.187	4.0358
21	-.090	0.076	0.595		0.095	0.220	0.512	0.501	0.592	0.317	-.014	0.445	0.530	3.2717
22	0.510	0.365	-.543	0.095		0.989	0.347	0.310	-.125	-.010	0.208	-.068	-.170	1.0504
23	0.320	0.410	-.370	0.220	0.989		0.359	0.318	0.089	-.126	0.151	-.060	-.163	8.4882
24	0.114	0.098	0.076	0.512	0.347	0.359		1.000	0.258	-.010	0.152	0.231	0.143	203.1723
25	0.085	0.086	0.098	0.501	0.310	0.318	1.000		0.261	0.000	0.144	0.226	0.147	0.3392
26	-.026	0.570	0.535	0.592	-.125	0.089	0.258	0.261		-.290	-.005	0.421	0.290	7.7692
27	-.162	-.463	0.049	0.317	-.010	-.126	-.010	0.000	-.290		-.041	-.257	0.430	4.8335
28	0.356	0.242	-.160	-.014	0.208	0.151	0.152	0.144	-.005	-.041		0.257	0.158	2.9385
29	0.236	0.547	0.254	0.445	-.068	-.060	0.231	0.226	0.421	-.257	0.257		0.614	2.6054
30	0.084	0.265	0.187	0.530	-.170	-.163	0.143	0.147	0.290	0.430	0.158	0.614		1.7645

Appendix

The solutions o communality obtained from the last two iterations of principal factor analysis - data B

a) Environmental correlation matrix of order 23.

(Three factor case)		(Four factor case)	
21st iteration	22nd iteration	34th iteration	35th iteration
.8259079	.8259260	.7512488	.7512483
.7215353	.7215351	.7395539	.7395538
.7387626	.7387631	.7835613	.7835614
.7081286	.7081291	.6781363	.6781364
.7167758	.7167759	.6927549	.6927544
.7181985	.7181997	.7134809	.7134804
.4307155	.4307160	.4270122	.4270121
.5469936	.5469948	.5623713	.5623718
.1811031	.1811032	.1809953	.1809953
.0199125	.0199125	.1887369	.1887336
.0112105	.0112105	.0822685	.0822670
.0156912	.0156912	.0160137	.0160136
.3365437	.3365438	.3363781	.3363779
.0765159	.0765159	.6148101	.6148160
.0800391	.0800390	.5907329	.5907362
.4592117	.4592101	.6287718	.6287710
.3523036	.3523041	.4034759	.4034752
.4431688	.4431689	.4797360	.4797362
.6996403	.6996268	.6717692	.6717688
.0291358	.0291358	.0295319	.0295319
.0333099	.0333099	.0206529	.0206529
.9136124	.9136133	.9476418	.9476426
.8363461	.8363465	.8526381	.8526388

b) Environmental correlation matrix of order 15

59th iteration	60th iteration
.443744	.443751
.583211	.583219
.713760	.713762
.464934	.464935
.562969	.562970
.186620	.186620
.075578	.075578
.336827	.336827
.718177	.718181
.759889	.759887
.275381	.275374
.209087	.209081
.040911	.040911
.020116	.020116
.790894	.790895

c) Genotypic correlation matrix of order 15

49th iteration	50th iteration
.627902	.627901
.617571	.617700
.021221	.021221
.137679	.137679
.677360	.677358
.369474	.369474
.667534	.667534
.761361	.761360
.633713	.633714
.557222	.557221
.696596	.696592
.536027	.536025
.433645	.433644
.155528	.155528
1.001849	1.001868

APPENDIX – 12. D^2 – Values based on 15 variables arranged in ascending order – data B.

	1		2		3		4		5		6
10	52.7	32	46.0	12	168.6	58	147.4	59	38.1	56	128.9
36	124.1	39	79.7	47	192.3	12	150.9	11	45.7	46	161.4
55	124.6	53	84.1	34	205.0	34	172.7	57	53.9	8	243.9
25	154.5	18	97.8	22	206.2	40	184.6	52	95.0	17	316.1
42	158.5	50	100.4	31	259.0	21	203.7	50	127.2	9	318.5
16	163.3	11	106.3	28	263.7	24	220.6	34	129.7	44	332.4
60	165.9	27	119.8	58	265.2	51	233.9	40	139.6	37	510.0
23	249.2	33	120.8	4	266.3	62	251.4	29	146.0	38	594.5
54	327.0	19	121.6	20	301.2	31	254.6	33	154.2	7	728.5
26	385.9	45	124.0	52	301.2	3	266.3	62	160.4	49	763.1
15	403.8	57	125.1	30	304.9	33	269.1	2	174.3	35	784.7
45	535.1	59	165.8	21	316.4	47	280.0	32	176.0	41	1109.0
27	553.1	62	171.1	24	350.3	30	285.0	14	185.6	43	1109.3
61	556.2	54	174.1	40	354.1	52	299.2	27	223.3	28	1147.1
14	577.6	5	174.3	51	424.8	22	320.5	19	229.2	20	1223.5
29	620.6	29	183.8	41	434.0	13	326.7	45	232.1	22	1477.0
19	702.1	48	202.0	13	446.1	50	343.5	18	241.4	30	1742.2
2	712.9	40	217.1	33	463.2	59	350.4	53	243.3	13	1845.6
18	745.7	23	219.1	62	465.8	11	366.1	48	247.5	47	2020.1
32	778.6	14	228.4	5	504.8	57	387.6	51	271.7	3	2146.7
48	787.3	51	230.4	43	505.5	53	413.8	12	294.5	31	2251.0
53	788.9	26	254.1	59	512.4	5	421.6	39	295.9	21	2614.6
50	895.4	61	254.2	49	513.5	20	439.3	26	298.6	58	2681.3
57	906.6	34	293.5	11	518.4	32	450.9	58	300.4	4	2759.8
39	920.6	52	308.8	57	550.4	28	460.7	24	306.8	51	2885.2
11	988.4	58	327.2	35	565.7	2	466.6	54	317.1	12	3005.7
59	993.6	24	328.3	50	621.6	29	540.5	61	318.8	24	3038.6
5	1024.1	21	362.7	32	814.1	18	559.9	31	327.2	34	3203.7
62	1181.8	31	396.7	29	853.8	45	602.3	21	350.0	40	3260.1
33	1212.3	60	418.2	2	855.3	39	603.8	47	404.2	33	3360.4
40	1405.7	36	427.9	53	870.8	43	609.9	23	416.2	52	3431.8
52	1478.8	16	462.4	38	907.2	41	636.3	4	421.6	62	3455.1
51	1501.7	4	466.6	18	939.6	14	719.4	3	504.8	39	3977.5
34	1572.9	12	501.5	39	983.0	19	757.2	60	562.2	50	3987.0
24	1618.1	25	503.1	48	1016.2	48	776.4	16	590.9	11	4104.8
21	1749.6	47	535.3	14	1025.6	61	780.0	30	641.5	5	4128.9
58	1756.0	13	611.6	45	1052.3	49	794.5	36	660.0	32	4169.2
12	1943.6	30	658.1	61	1158.4	27	820.9	13	679.7	59	4240.0
4	1970.3	10	674.8	19	1162.0	54	911.0	25	904.9	53	4252.6
31	2032.0	1	712.9	27	1225.7	23	998.1	20	916.8	18	4286.4
47	2308.7	3	855.3	54	1339.2	38	1044.9	10	965.5	57	4309.5
13	2443.4	55	920.0	17	1355.7	35	1065.9	28	987.1	2	4359.0
30	2532.9	42	979.4	44	1425.4	26	1087.3	1	1024.1	48	4582.3
3	2766.2	20	1077.8	26	1496.9	60	1228.0	22	1050.7	45	4847.4
20	3321.1	43	1165.4	23	1535.5	36	1315.4	55	1068.7	19	4851.1
43	3460.1	28	1176.4	8	1589.9	16	1465.2	41	1149.3	29	5055.4
22	3500.6	22	1253.0	60	1841.9	44	1642.4	43	1164.6	27	5228.2
28	3547.3	41	1331.1	16	2017.4	17	1667.7	42	1220.1	14	5431.9
41	3787.1	15	1677.3	36	2029.5	25	1792.8	15	1745.0	54	5613.8
38	4730.8	38	1941.8	6	2146.7	10	1873.1	49	1760.5	61	5678.8
49	4778.3	49	1963.6	9	2288.7	1	1970.3	38	1951.6	23	6155.1
35	5458.7	35	2393.8	56	2330.9	8	2042.2	35	1966.5	26	6241.6
44	5957.9	44	2764.2	25	2548.0	55	2256.7	17	2713.5	60	6955.0
17	6114.7	17	2831.1	10	2623.2	42	2431.6	44	2785.5	36	6990.6
8	7342.7	8	3744.5	1	2766.2	9	2739.8	8	3494.8	16	7419.1
6	8357.6	6	4359.0	55	2921.2	6	2759.8	6	4129.9	25	7594.0
9	8434.2	9	4529.6	46	3070.0	56	2992.6	9	4326.4	10	8240.8
56	9021.1	56	4898.7	42	3153.9	15	3167.0	56	4556.5	1	8357.6
46	10309.8	46	5815.8	15	3884.8	46	3767.6	46	5517.7	55	9059.8
37	12574.2	37	7585.5	37	4302.8	37	5234.2	37	7182.3	42	9329.7
7	13786.1	7	8469.5	7	5206.8	7	6077.6	7	8194.5	15	11081.3

	7		8		9		10		11		12
37	234.5	9	190.4	8	190.4	1	52.7	57	34.6	34	60.5
46	316.8	56	200.8	56	283.4	60	98.4	59	47.3	24	140.2
6	728.5	6	243.9	46	293.8	42	104.1	5	48.7	52	144.3
56	748.9	44	282.5	6	318.5	16	133.4	2	106.3	4	150.9
9	946.2	17	304.3	17	343.5	55	137.4	34	116.1	3	168.6
8	1274.1	46	359.4	44	353.7	36	194.6	33	134.8	21	216.5
17	1621.9	49	365.5	38	634.7	25	212.6	29	141.6	58	222.2
44	1695.7	38	420.0	49	837.6	23	278.1	50	141.8	33	232.5
38	2409.9	35	500.0	7	946.2	54	293.0	32	145.0	62	243.3
35	2643.6	43	850.2	37	961.3	26	325.7	52	150.0	57	264.3
49	2728.7	28	882.7	35	1021.0	15	393.4	40	154.7	40	266.2
41	3455.2	22	907.4	43	1239.4	61	397.7	62	165.9	11	268.5
43	3515.4	37	910.3	28	1325.6	14	441.2	14	168.4	59	291.7
28	3608.6	20	938.4	20	1410.4	29	536.6	53	204.5	5	294.5
20	3733.5	41	943.6	41	1471.4	45	557.3	27	221.1	31	295.3
22	4075.2	7	1274.1	22	1522.8	27	591.7	19	221.3	47	314.4
30	4601.3	30	1349.6	13	1922.2	2	674.8	61	224.5	51	351.3
13	4692.3	13	1466.2	30	1962.3	19	678.0	24	250.1	50	379.2
47	5092.5	3	1589.9	47	2237.5	48	741.8	45	250.7	22	392.7
3	5206.8	47	1675.6	3	2288.7	53	771.2	18	253.1	30	397.1
31	5425.9	31	1885.9	31	2458.4	18	790.8	58	260.4	29	472.0
21	6014.4	4	2042.2	58	2677.2	32	802.2	12	268.5	2	501.5
58	6049.2	21	2057.6	4	2739.8	57	814.3	51	268.8	14	542.7
4	6077.6	58	2075.5	21	2834.8	50	889.6	39	270.5	13	544.0
51	6347.6	51	2335.4	51	2904.1	11	909.5	26	287.4	28	548.0
12	6548.9	12	2353.3	40	3202.6	59	915.8	54	294.8	32	559.8
24	6628.4	24	2447.2	12	3249.7	39	922.9	48	306.9	20	570.9
40	6865.0	34	2568.6	24	3406.3	5	965.5	21	342.7	53	581.6
34	6868.6	40	2601.5	34	3431.0	62	1088.0	31	344.3	61	585.8
33	7123.6	62	2800.6	62	3658.6	33	1107.4	23	353.4	48	626.8
52	7192.4	33	2830.1	33	3669.0	52	1336.5	4	366.1	18	627.2
62	7225.0	52	2833.0	52	3732.9	40	1399.8	47	419.5	45	670.8
39	7897.9	50	3272.1	50	4019.8	34	1429.4	3	518.4	39	684.6
50	7976.8	11	3454.4	32	4179.8	24	1438.9	60	530.3	41	723.9
11	8149.9	5	3494.8	53	4246.3	51	1519.8	16	537.8	19	748.8
32	8165.9	59	3496.5	39	4247.9	21	1659.9	30	616.7	43	784.0
5	8194.5	53	3503.2	11	4293.9	58	1719.6	13	652.6	54	799.1
53	8231.6	32	3507.6	59	4319.7	12	1775.0	36	661.0	27	850.5
59	8307.5	39	3568.9	5	4326.4	4	1873.1	25	804.9	26	951.8
18	8370.0	57	3591.9	18	4348.9	31	1976.9	10	909.5	49	964.7
2	8469.5	18	3659.5	57	4483.3	47	2254.0	20	952.6	23	976.3
57	8475.4	2	3744.5	2	4529.6	13	2407.5	28	985.7	35	1090.4
48	8886.4	45	4031.2	45	4838.7	30	2440.3	1	988.4	60	1146.8
19	9120.2	48	4078.0	48	5003.4	3	2623.2	22	1001.5	36	1354.2
45	9121.3	29	4139.9	29	5125.8	20	3247.0	55	1080.4	38	1371.7
29	9449.9	19	4398.2	19	5183.6	22	3354.6	43	1128.5	16	1380.2
27	9608.1	14	4621.4	27	5338.9	43	3433.0	41	1160.6	10	1775.0
14	9998.1	27	4630.3	14	5726.7	28	3453.6	42	1184.0	25	1819.8
54	10278.8	61	4824.4	54	5898.5	41	3615.0	49	1691.1	1	1943.6
61	10334.1	54	4860.7	61	6004.6	49	4615.3	15	1763.5	44	2047.7
23	10937.1	23	5273.5	23	6169.2	38	4707.2	38	1890.9	17	2056.9
26	11055.2	26	5558.3	26	6542.6	35	5212.7	35	1950.2	55	2094.8
36	11977.1	60	5922.9	36	6908.0	44	5965.6	17	2695.5	42	2244.5
60	11986.3	36	5970.3	60	7092.5	17	6078.3	44	2715.6	8	2353.3
16	12581.4	16	6468.8	16	7524.6	8	7234.8	8	3454.4	15	2851.3
25	12740.1	25	6862.5	25	7762.1	6	8240.8	5	4104.8	6	3005.7
10	13664.4	10	7234.8	1	8434.2	9	8444.6	9	4293.9	56	3223.5
1	13786.1	1	7342.7	10	8444.6	56	9884.8	58	4575.2	9	3249.7
55	14750.6	55	8062.4	55	9186.1	46	10180.7	46	5501.0	46	4131.3
42	15067.6	42	8400.0	42	9633.4	37	12347.0	37	7199.7	37	5455.4
15	17327.4	15	9855.4	15	11226.3	7	13664.4	7	8149.9	7	6548.9

	13		14		15		16		17		18
30	62.5	29	65.4	55	177.7	60	115.4	44	102.7	32	56.4
31	104.1	61	67.8	42	220.3	26	119.7	38	152.1	50	64.3
47	117.6	57	137.3	10	393.4	10	133.4	8	304.3	45	70.9
20	143.1	26	142.5	1	403.8	55	156.9	5	316.1	2	97.8
43	151.0	54	152.3	16	470.2	1	163.3	9	343.5	39	99.9
58	174.2	11	168.4	60	613.7	42	181.5	49	406.5	53	141.7
51	180.9	59	170.3	36	702.0	23	188.4	43	497.6	48	150.5
21	194.1	60	182.1	25	723.1	25	199.2	41	515.4	51	169.5
28	200.5	5	185.6	26	803.6	36	229.1	20	544.3	33	182.9
41	277.9	2	228.4	23	874.4	14	259.2	28	546.8	27	185.9
40	322.7	45	252.5	54	1044.0	54	266.8	35	558.8	54	200.0
4	326.7	16	259.2	61	1059.1	61	280.9	56	576.4	62	203.3
33	345.4	19	274.6	14	1103.2	27	317.4	46	662.0	40	214.9
62	359.5	23	277.5	29	1268.3	29	324.0	13	870.4	57	218.4
22	373.8	62	290.7	27	1322.1	45	429.7	30	892.6	19	228.7
24	398.6	27	298.2	45	1454.1	19	444.8	22	901.8	23	238.5
38	425.9	50	303.9	19	1543.3	2	462.4	47	1100.6	5	241.4
34	436.4	53	304.0	57	1616.2	15	470.2	31	1240.6	11	253.1
3	446.1	52	306.1	48	1652.7	57	512.1	3	1355.7	59	271.3
50	495.9	33	308.0	2	1677.3	59	537.8	37	1486.4	29	272.0
39	500.5	48	312.9	59	1714.7	11	537.8	58	1563.8	58	316.0
32	511.5	32	318.1	5	1745.0	32	541.3	21	1618.8	21	343.3
52	527.6	34	347.0	11	1763.5	53	552.6	7	1621.9	36	378.4
53	530.2	18	390.2	18	1814.7	5	590.9	4	1657.7	14	390.2
12	544.0	24	417.5	32	1834.6	18	634.3	51	1674.3	31	393.1
18	574.1	36	429.2	53	1868.6	50	655.4	40	1927.5	52	406.9
49	576.0	10	441.2	50	1876.8	48	663.6	24	2006.3	34	416.0
2	611.6	39	452.8	39	2112.2	39	740.3	12	2056.9	26	429.6
11	652.6	40	487.5	63	2265.2	62	864.0	34	2077.5	24	463.6
5	679.7	12	542.7	33	2307.2	33	876.3	33	2152.6	61	478.5
59	688.0	1	577.6	53	2330.7	40	981.7	62	2183.0	60	527.1
57	713.9	25	611.5	40	2470.6	52	981.9	52	2250.7	47	535.1
45	762.4	21	629.6	34	2486.0	34	1038.1	39	2519.4	4	559.9
48	820.0	55	530.9	24	2739.6	24	1186.0	50	2554.7	13	574.1
44	854.3	51	643.1	51	2818.6	51	1191.3	32	2589.0	25	613.5
17	870.4	42	560.6	12	2851.3	53	1324.1	53	2629.9	12	627.2
19	888.7	58	670.5	58	3016.1	12	1380.2	11	2695.5	16	634.3
35	932.5	4	719.4	21	3067.9	21	1404.0	5	2713.5	30	676.6
29	951.0	31	794.0	4	3167.0	4	1465.2	59	2752.6	1	745.7
27	997.2	47	922.7	31	3404.4	31	1557.8	18	2766.3	10	790.8
54	1179.1	3	1025.6	47	3699.8	47	1757.7	2	2831.1	3	939.6
14	1182.5	30	1093.2	3	3884.8	13	2014.8	57	2902.4	55	983.6
61	1337.2	15	1103.2	13	4149.1	3	2017.4	45	3168.0	20	1042.0
23	1371.9	13	1182.5	30	4158.6	30	2046.5	48	3212.6	43	1078.4
8	1466.2	20	1585.5	22	5037.0	20	2715.6	19	3218.0	28	1166.1
26	1507.7	22	1613.7	20	5044.3	22	2829.6	29	3418.8	42	1167.8
36	1727.8	28	1690.9	28	5223.7	28	2865.1	27	3445.5	22	1274.3
60	1775.5	41	1791.4	43	5397.2	43	2964.9	14	3802.0	41	1412.3
6	1845.6	43	1873.5	41	5544.7	41	3052.9	54	3966.0	15	1814.7
9	1922.2	49	2525.2	49	6695.9	49	3954.7	61	4100.8	38	1861.7
16	2014.8	35	2804.0	38	7028.0	38	4128.2	23	4318.7	49	2036.8
25	2086.0	38	2830.9	35	7191.0	35	4411.7	26	4392.2	35	2545.1
56	2198.4	17	3802.0	44	8545.8	17	5304.7	36	4951.8	44	2658.7
10	2407.5	44	3846.7	17	8602.2	44	5307.7	60	4994.8	17	2755.3
1	2443.4	8	4621.4	8	9855.4	8	6468.8	16	5304.7	8	3659.5
46	2786.2	6	5431.9	6	11081.3	6	7419.1	25	5450.7	5	4286.4
55	2869.1	9	5726.7	9	11226.3	9	7524.6	10	6078.3	9	4348.9
42	3055.5	56	5929.7	56	11700.6	56	9076.5	1	6114.7	56	4731.5
37	4108.7	46	7004.5	46	13289.5	46	9241.7	55	6752.3	46	5725.7
15	4149.1	37	8764.5	37	15771.3	37	11438.6	42	7010.3	37	7486.6
7	4692.3	7	9998.1	7	17327.4	7	12581.4	15	8602.2	7	8370.0

	19		20		21		22		23		24
27	57.1	28	59.5	63	82.9	28	149.5	54	108.5	33	82.7
39	118.0	30	86.0	24	90.7	49	194.3	36	113.0	62	89.9
2	121.6	41	100.5	33	92.8	3	206.3	45	179.6	21	90.7
26	153.6	43	111.9	58	109.4	20	229.2	60	180.6	34	94.4
32	177.7	47	137.8	51	116.9	30	274.8	16	188.4	52	139.5
11	221.3	13	143.1	31	122.4	43	302.7	27	209.2	12	140.2
18	228.7	31	199.2	30	130.2	4	320.5	2	219.1	4	220.6
5	229.2	22	229.2	47	146.4	41	330.8	26	222.2	58	237.3
53	245.0	38	272.9	34	158.3	47	340.0	25	223.6	30	245.2
54	254.3	49	272.9	13	194.1	58	367.3	29	236.3	31	246.1
45	257.4	3	301.3	4	203.7	35	373.8	18	238.5	57	247.6
48	263.2	21	332.3	52	206.5	13	373.8	61	247.3	11	250.1
14	274.6	58	380.8	50	310.1	12	392.7	1	249.2	47	279.7
59	276.9	51	427.8	40	213.4	21	397.0	32	256.5	51	282.7
57	279.5	4	439.3	12	216.5	31	433.5	14	277.6	50	292.5
33	284.9	35	443.8	57	313.5	38	496.4	10	278.1	59	300.5
50	286.6	24	531.3	3	316.4	34	514.4	50	295.3	40	300.9
23	335.0	17	544.3	20	332.2	24	530.4	57	299.8	5	306.9
29	341.6	40	545.3	32	337.0	51	598.7	53	334.3	2	328.2
62	363.9	34	557.9	53	339.3	40	657.6	19	335.0	3	350.3
61	377.6	12	570.9	11	342.7	62	714.2	48	344.3	53	353.7
40	392.9	44	595.2	18	343.3	52	719.9	11	353.4	29	368.4
25	429.9	33	598.8	5	350.0	33	739.3	55	361.5	32	394.1
52	430.8	62	609.5	59	357.8	44	864.0	59	390.3	13	398.6
16	444.8	52	634.1	2	362.7	17	901.8	39	406.9	14	417.5
51	455.7	50	850.5	39	380.0	8	907.4	5	416.8	48	434.0
60	485.2	5	916.8	22	397.0	50	962.3	42	499.7	39	436.0
34	496.8	8	938.4	48	398.1	11	1001.5	33	531.5	61	457.9
36	518.0	39	951.6	28	416.1	59	1016.5	63	544.5	18	463.6
31	565.1	11	952.6	43	417.7	57	1021.3	40	594.0	45	482.2
24	579.9	32	961.0	45	431.0	5	1050.7	51	656.8	22	530.4
58	616.5	59	962.8	29	471.3	53	1182.2	34	728.9	20	531.3
21	651.5	53	988.7	41	536.4	32	1183.3	52	749.4	54	554.5
10	678.0	57	1024.5	54	629.1	2	1253.0	58	773.9	19	579.9
1	702.1	18	1042.0	14	629.6	18	1274.3	24	847.4	28	616.2
47	739.6	2	1077.8	19	651.5	39	1329.0	15	874.4	41	654.9
12	748.8	48	1218.9	61	707.4	29	1347.8	21	880.1	43	698.2
4	757.2	6	1223.5	27	755.7	45	1436.5	12	976.3	27	729.7
55	815.1	45	1264.1	49	839.6	48	1453.8	4	998.1	26	816.8
42	831.6	19	1349.3	23	880.1	6	1477.0	31	1045.0	23	847.4
13	888.7	39	1354.1	38	935.5	9	1522.8	47	1233.9	60	908.1
30	948.1	9	1410.4	26	1013.7	56	1537.0	13	1371.9	49	1015.4
3	1162.0	56	1494.3	60	1098.3	14	1613.7	30	1470.7	36	1151.5
20	1349.3	27	1517.8	36	1161.0	61	1703.1	3	1535.5	16	1186.0
28	1464.3	14	1585.5	35	1186.7	19	1709.1	20	2045.3	35	1271.0
43	1538.5	54	1722.3	16	1404.0	27	1849.0	22	2071.1	38	1284.0
15	1543.3	61	1805.1	44	1523.9	54	1853.2	43	2095.6	10	1438.9
41	1550.8	46	2001.7	17	1618.8	23	2071.1	28	2122.5	25	1507.6
22	1709.1	26	2043.1	25	1625.9	46	2305.2	41	2455.0	1	1618.1
38	2368.4	23	2045.3	10	1559.9	26	2266.6	38	3137.9	55	1912.7
49	2482.7	60	2434.3	1	1749.6	60	2454.9	49	3140.0	42	1957.8
35	2808.4	36	2473.7	8	2057.6	36	2589.3	35	3713.2	44	1963.0
17	3218.0	16	2715.6	55	2096.2	16	2829.6	44	4160.7	17	2006.3
44	3261.5	25	2968.8	42	2258.2	37	3261.2	17	4318.7	8	2447.2
8	4398.2	37	3091.0	6	2614.6	25	3264.7	8	5273.5	15	2739.6
6	4851.1	10	3247.0	9	2834.8	10	3354.6	6	6155.1	6	3038.6
9	5183.6	1	3321.1	56	2907.9	1	3500.6	9	6169.2	56	3400.9
56	5519.0	55	3726.7	15	3067.9	55	3859.9	56	6659.1	9	3406.3
46	6445.3	7	3733.5	46	3737.1	7	4075.2	46	7856.1	46	4222.8
37	8242.3	42	3938.7	37	5050.3	42	4134.3	37	9882.2	37	5544.4
7	9120.2	15	5044.3	7	6014.4	15	5037.0	7	10937.1	7	6628.4

	25		26		27		28		29		30
1	154.5	16	118.7	19	67.1	20	59.6	14	65.4	13	62.5
16	199.2	27	133.0	2	119.8	41	113.1	57	84.8	20	86.0
10	212.6	14	142.5	32	128.1	43	137.8	59	93.1	47	93.1
23	223.6	19	153.6	26	133.0	22	149.5	45	126.4	31	104.5
42	245.4	54	201.5	39	171.5	47	169.3	61	141.0	21	130.2
55	255.7	61	211.9	18	185.9	30	174.5	11	141.6	43	153.4
36	266.8	23	222.2	45	196.1	13	200.5	5	146.0	28	174.5
26	275.4	60	224.9	23	209.2	49	235.4	50	154.4	41	199.4
27	326.0	29	247.7	11	221.1	31	251.1	53	167.5	58	215.7
60	348.2	2	254.1	5	223.3	3	263.7	54	170.6	51	238.3
54	349.7	25	275.4	53	224.6	38	278.7	2	183.8	24	245.2
19	429.9	11	287.4	54	245.7	58	365.0	62	186.4	22	274.6
2	503.1	57	291.8	50	245.9	35	371.9	32	196.5	4	285.0
45	544.6	5	298.6	59	247.9	21	416.1	60	212.3	33	299.5
61	571.4	59	309.8	57	266.9	4	460.7	23	236.3	3	304.9
32	602.7	10	325.7	29	291.8	51	499.4	26	247.7	62	309.6
14	611.5	45	332.1	14	298.2	17	546.8	33	252.1	34	338.6
18	613.5	36	343.7	15	317.4	12	548.0	52	257.9	40	359.7
39	621.6	32	355.6	48	323.7	34	571.4	18	272.0	12	397.1
53	680.9	55	357.3	25	326.0	44	591.3	34	273.6	52	407.0
29	692.3	42	364.9	40	355.6	40	608.4	27	291.8	49	440.3
48	701.3	48	381.5	36	358.8	24	616.2	48	303.9	35	443.2
15	723.1	1	385.9	33	379.1	33	692.4	40	312.6	50	533.0
11	804.9	53	403.2	61	403.9	52	706.4	16	324.0	39	590.0
57	812.4	39	423.9	60	424.6	62	728.1	19	341.6	53	591.0
50	813.8	18	429.6	62	435.7	8	882.7	36	349.3	32	596.9
59	900.5	50	440.3	51	451.5	50	953.9	24	368.4	11	616.7
5	904.9	33	528.5	52	507.0	11	985.7	39	417.3	5	641.5
33	1042.6	62	574.4	1	553.1	5	987.1	51	450.7	2	658.1
62	1121.6	52	582.5	34	566.0	59	1026.0	58	469.3	59	664.0
40	1212.0	40	653.7	10	591.7	57	1065.2	21	471.3	57	676.5
51	1275.1	34	667.0	58	632.9	32	1079.7	12	472.0	18	676.6
52	1385.8	15	803.6	55	644.1	39	1080.4	10	536.6	35	717.9
34	1430.9	24	816.8	31	659.7	6	1147.1	4	540.5	48	827.8
24	1507.6	51	836.6	42	726.3	53	1149.3	1	620.6	45	829.3
58	1528.7	12	951.8	24	729.7	18	1166.1	31	656.0	44	879.2
21	1625.9	58	969.2	21	755.7	2	1176.4	25	692.3	17	892.6
31	1707.8	21	1013.7	4	820.9	9	1325.6	55	733.4	29	909.7
4	1792.8	31	1041.6	47	841.3	48	1332.1	47	761.2	19	948.1
12	1819.8	4	1087.3	12	850.5	56	1377.5	42	853.0	14	1093.2
47	1974.5	47	1219.6	13	997.2	45	1430.8	3	853.8	27	1101.5
13	2086.0	3	1496.9	30	1101.5	19	1464.3	30	909.7	54	1165.2
30	2245.4	13	1507.7	3	1225.7	29	1468.8	13	951.0	61	1333.1
3	2548.0	30	1515.1	15	1322.1	27	1639.7	15	1268.3	8	1349.6
20	2968.8	20	2043.1	20	1517.8	14	1690.9	22	1347.8	23	1470.7
43	3027.4	28	2166.5	28	1539.7	54	1870.0	20	1354.1	26	1515.1
28	3122.6	22	2266.6	43	1675.9	61	1876.6	28	1468.8	6	1742.2
22	3264.7	41	2296.5	41	1828.6	46	1933.4	43	1598.3	60	1758.0
41	3351.8	43	2325.9	22	1849.0	23	2122.5	41	1628.8	36	1839.9
38	4189.6	49	3255.4	38	2552.7	26	2166.5	49	2196.1	9	1962.3
49	4398.7	38	3380.9	49	2673.1	60	2616.9	38	2484.3	16	2046.6
35	5034.7	35	3564.6	35	3065.8	36	2668.8	35	2556.7	56	2084.5
44	5320.6	17	4392.2	17	3445.5	16	2865.1	17	3418.8	25	2245.4
17	5450.7	44	4453.0	44	3467.8	37	2989.4	44	3427.9	10	2440.3
8	6862.5	8	5558.3	8	4630.3	25	3122.6	8	4139.9	1	2532.9
6	7594.0	6	6241.5	6	5228.2	10	3453.6	6	5055.4	46	2666.9
9	7762.1	9	6542.6	9	5338.9	1	3547.3	9	5125.8	55	2968.2
56	8386.7	56	6896.5	56	5862.0	7	3608.6	56	5454.8	42	3101.5
46	9542.6	46	7980.8	46	6819.6	55	3881.5	46	6496.5	37	3862.5
37	11783.8	37	9966.1	37	8787.3	42	4130.0	37	8303.9	15	4158.6
7	12740.1	7	11055.2	7	9608.1	15	5223.7	7	9449.9	7	4601.3

	31		32		33		34		35		36
47	38.5	2	46.0	62	34.0	52	48.9	49	131.3	23	113.0
51	89.8	53	46.5	24	82.7	12	60.5	41	329.7	1	124.1
13	104.1	18	56.4	21	92.8	24	94.4	28	371.9	60	143.8
30	104.5	50	59.2	50	104.5	33	108.2	22	373.8	10	194.6
58	110.5	45	74.6	34	108.2	62	111.1	20	443.8	54	204.9
21	122.4	39	98.5	52	113.7	11	116.1	8	500.0	45	217.6
40	148.5	27	128.1	2	120.8	57	119.4	38	558.5	16	229.1
33	160.9	40	140.0	57	128.0	59	129.5	17	558.8	25	256.8
20	199.2	11	145.0	51	130.5	5	129.7	3	565.7	55	293.7
34	202.7	51	153.3	11	134.8	40	147.7	43	651.1	26	343.7
62	307.6	33	157.8	5	154.2	58	149.1	30	717.9	29	349.3
52	230.1	59	157.9	32	157.5	21	158.3	44	732.3	27	358.8
24	246.1	57	160.4	39	158.9	4	172.7	6	784.7	18	378.4
28	251.1	62	163.1	40	160.6	31	202.7	47	839.7	2	427.9
4	254.6	5	176.0	31	160.9	3	205.0	56	882.9	32	428.4
3	259.0	19	177.7	58	171.7	50	214.6	13	932.5	14	429.2
43	292.3	29	196.5	59	173.1	47	226.2	31	1005.2	42	433.4
50	293.6	54	239.3	53	175.3	51	233.2	9	1021.0	53	439.0
12	295.3	23	256.5	18	182.9	29	273.6	4	1065.9	61	439.2
5	327.2	48	256.9	48	190.5	2	293.5	12	1090.4	50	452.3
39	328.9	58	263.3	12	232.5	32	325.1	21	1186.7	48	504.8
32	344.2	14	318.1	45	242.5	30	338.6	58	1198.8	19	518.0
11	344.3	34	325.1	47	243.0	53	341.2	46	1223.5	57	557.9
41	356.8	52	333.9	29	252.1	14	347.0	34	1252.1	39	612.9
59	377.2	21	337.0	4	269.1	18	416.0	24	1271.0	59	614.9
18	393.1	31	344.2	19	284.9	48	417.3	52	1425.0	5	660.0
2	396.7	26	355.6	30	299.5	61	431.3	51	1497.1	11	661.0
57	398.6	24	394.1	14	308.0	45	433.2	40	1511.4	15	702.0
53	418.8	61	407.6	54	325.8	13	436.4	33	1628.2	62	732.5
22	433.5	36	428.4	13	345.4	39	446.5	62	1628.5	33	792.9
48	523.1	4	450.9	61	373.8	19	496.8	11	1950.2	40	848.5
19	555.1	47	464.9	27	379.1	22	514.4	59	1965.0	51	927.9
45	567.0	60	499.1	3	463.2	20	557.9	5	1966.5	52	1006.5
29	655.0	13	511.5	26	528.5	54	563.7	37	1984.0	34	1070.6
27	659.7	16	541.3	23	531.5	27	566.0	57	2076.6	58	1132.4
38	724.6	12	559.8	20	598.8	28	571.4	50	2093.1	24	1151.5
49	767.2	30	596.9	28	692.4	26	667.0	53	2289.2	21	1161.0
14	794.0	25	602.7	60	693.1	41	703.4	32	2314.9	4	1315.4
54	846.8	1	778.6	43	727.8	23	728.9	2	2393.8	12	1354.2
61	946.4	10	802.2	22	739.3	43	769.4	39	2400.1	31	1411.9
35	1005.2	3	814.1	41	783.8	60	880.6	18	2545.1	47	1653.4
26	1041.6	20	961.0	36	792.9	16	1038.1	29	2556.7	13	1727.8
23	1045.0	55	1015.9	16	876.3	36	1070.6	7	2643.5	30	1839.9
17	1240.6	43	1042.4	25	1042.6	49	1078.1	48	2688.8	3	2029.5
44	1261.4	28	1079.7	10	1107.4	35	1252.1	45	2762.8	20	2473.7
60	1402.4	42	1156.1	1	1212.3	38	1397.8	14	2804.0	22	2559.3
36	1411.9	22	1183.3	49	1308.8	10	1429.4	19	2808.4	43	2596.6
16	1557.8	41	1268.8	38	1387.9	25	1430.9	61	3002.5	28	2668.8
25	1707.8	38	1760.2	55	1453.8	1	1572.9	27	3065.8	41	2960.7
8	1885.9	15	1834.6	42	1532.6	55	1707.0	54	3312.3	38	3705.6
10	1976.9	49	1849.4	35	1628.2	42	1842.5	26	3564.6	49	3742.1
1	2032.0	35	2314.9	44	2109.0	17	2077.5	23	3713.2	35	4392.2
6	2251.0	44	2546.5	17	2152.6	44	2114.6	60	4070.8	44	4792.1
55	2305.7	17	2589.0	15	2307.2	15	2486.0	36	4392.2	17	4951.8
9	2458.4	8	3507.6	8	2830.1	8	2568.6	16	4411.7	8	5970.3
42	2469.0	6	4169.2	6	3360.4	6	3203.7	25	5034.7	9	6908.0
56	2631.6	9	4179.8	9	3669.0	9	3431.0	10	5212.7	6	6990.6
46	3337.6	56	4671.4	56	3785.4	56	3519.0	1	5458.7	56	7473.6
15	3404.4	46	5551.3	46	4661.1	46	4400.6	55	5809.7	46	8703.5
37	4690.7	37	7364.7	37	6136.3	37	5841.7	42	6011.5	37	10856.2
7	5425.9	7	8165.9	7	7123.6	7	6868.6	15	7191.0	7	11977.1

	37		38		39		40		41		42
46	234.3	44	90.5	2	79.7	51	75.0	20	100.5	55	78.7
7	234.5	43	133.7	32	93.5	58	97.9	28	113.1	10	104.1
56	414.3	17	152.1	18	99.9	50	100.1	30	199.4	1	158.5
6	510.0	49	248.6	19	118.0	59	128.4	43	264.9	16	181.5
8	910.3	20	272.9	33	158.9	5	139.6	49	276.2	15	220.3
9	961.3	28	278.7	53	170.5	32	140.0	13	277.9	25	245.4
17	1486.4	41	351.9	27	171.5	34	147.7	47	288.0	60	312.3
44	1519.5	8	420.0	50	181.0	31	148.5	35	329.7	26	364.9
35	1984.0	13	425.9	48	197.4	62	153.9	22	330.8	36	433.4
38	2072.9	30	443.2	51	209.3	11	154.7	38	351.9	23	499.7
49	2124.6	22	496.4	45	214.8	33	160.6	31	356.8	54	555.6
41	2825.4	35	558.5	62	242.1	57	175.7	3	434.0	61	633.6
43	2959.1	6	594.5	11	270.5	52	179.6	17	515.4	14	660.6
28	2989.4	9	634.7	40	293.0	4	184.6	21	536.4	27	726.3
20	3091.0	47	647.9	54	293.1	53	198.4	58	598.6	19	831.6
22	3261.2	31	724.5	5	295.9	21	213.4	4	636.3	29	853.0
30	3862.5	56	844.9	57	310.6	18	214.9	24	654.9	45	931.5
13	4108.7	3	907.2	31	328.9	2	217.1	44	658.1	2	979.4
3	4302.8	58	920.5	59	344.7	47	219.2	34	703.4	48	1044.9
47	4362.1	21	935.5	21	380.0	12	266.2	51	721.3	57	1115.6
31	4690.7	51	989.7	58	389.4	45	267.4	12	723.9	32	1156.1
21	5050.3	4	1044.9	23	406.9	39	293.0	52	779.3	18	1167.8
4	5234.2	46	1150.6	52	416.0	24	300.9	33	783.8	53	1173.6
58	5274.5	40	1266.7	29	417.3	29	312.6	62	805.6	11	1184.0
12	5465.4	24	1284.0	26	423.9	13	322.7	40	829.3	59	1201.7
24	5544.4	12	1371.7	24	435.0	3	354.1	8	943.5	5	1220.1
51	5598.2	33	1387.9	34	446.5	27	355.6	6	1109.0	39	1242.0
34	5841.7	34	1397.8	14	452.8	30	359.7	5	1149.3	50	1293.0
40	6078.0	62	1427.5	47	485.5	19	392.9	11	1160.6	33	1532.6
52	6103.8	52	1578.2	13	500.5	48	440.5	50	1183.1	62	1563.8
33	6136.3	50	1698.9	61	530.5	14	487.6	39	1189.5	52	1698.9
62	6208.4	39	1702.1	30	590.0	20	545.3	59	1192.4	40	1814.4
50	7024.2	32	1760.2	4	603.8	54	563.9	53	1247.1	34	1842.5
39	7113.1	53	1811.2	36	612.9	23	594.0	32	1258.8	24	1957.8
5	7182.3	18	1861.7	25	621.6	28	608.4	57	1274.5	51	2020.5
11	7188.7	11	1890.9	60	680.6	61	620.9	2	1331.1	12	2244.5
59	7320.8	2	1941.8	12	684.6	26	653.7	18	1412.3	58	2257.8
32	7364.7	5	1951.6	16	740.3	22	657.6	56	1439.5	21	2258.2
53	7390.7	59	1982.3	1	920.6	43	686.6	9	1471.4	4	2431.6
57	7403.7	57	2038.2	10	922.9	41	829.3	48	1495.9	31	2469.0
18	7486.6	37	2072.9	20	951.6	36	848.5	19	1550.8	47	2774.9
2	7585.5	45	2217.4	3	983.0	60	896.5	45	1622.0	13	3055.5
48	7736.7	48	2253.1	43	995.6	16	981.7	29	1628.8	30	3101.5
45	8135.5	19	2368.4	28	1080.4	49	1209.9	14	1791.4	3	3153.9
19	8243.3	7	2409.9	41	1189.5	25	1212.0	27	1828.6	20	3938.7
29	8303.9	29	2481.3	55	1192.0	38	1266.7	46	1861.5	28	4130.0
14	8764.6	27	2552.7	42	1242.0	10	1399.8	61	2016.0	22	4134.3
27	8787.3	14	2830.9	22	1329.0	1	1405.7	54	2058.2	43	4202.3
61	9049.5	54	2839.3	38	1702.1	35	1511.4	26	2296.5	41	4288.1
54	9080.5	61	2996.5	49	1949.2	55	1595.3	23	2465.0	49	5506.0
23	9882.2	23	3137.9	15	2113.2	42	1814.4	60	2759.2	38	5612.6
26	9966.1	26	3380.9	35	2400.1	17	1927.5	37	2825.4	35	6011.5
60	10694.9	36	3705.6	44	2449.1	44	1954.1	36	2960.7	44	6976.7
36	10858.2	60	3775.7	17	2519.4	15	2470.6	16	3052.9	17	7010.3
16	11438.6	16	4128.2	8	3568.9	8	2601.5	25	3351.8	8	8400.0
25	11783.8	25	4189.6	6	3977.5	9	3202.6	7	3455.2	6	9329.7
10	12347.0	10	4707.2	9	4247.9	6	3260.1	10	3615.0	9	9633.4
1	12574.2	1	4730.8	56	4584.7	56	3591.3	1	3787.1	56	10092.2
55	13457.7	55	5377.2	46	5438.0	46	4427.7	55	4164.0	46	11442.2
42	13742.5	42	5612.6	37	7113.1	37	5078.0	42	4288.1	37	13742.5
15	15771.3	15	7028.0	7	7897.9	7	6865.0	15	5544.7	7	15067.6

	43		44		45		46		47		48
20	111.9	38	90.5	18	70.9	56	146.5	31	38.5	18	150.5
28	127.9	17	102.7	32	74.6	6	161.4	30	93.1	54	152.0
38	133.7	8	282.5	53	78.8	37	334.3	13	117.6	50	183.1
13	151.0	6	332.4	50	80.0	9	293.8	58	129.1	33	190.5
30	153.4	9	353.7	2	124.0	7	316.8	20	137.8	39	197.4
47	253.5	43	402.8	29	126.4	8	359.4	21	146.4	2	202.0
41	264.9	49	414.0	54	137.7	17	662.0	51	160.4	45	212.9
31	292.3	56	569.1	23	179.6	44	723.1	28	169.3	57	234.2
22	303.7	28	591.3	62	189.6	38	1150.6	3	192.3	62	237.7
49	319.3	20	595.2	27	196.1	35	1223.5	40	219.2	5	247.5
44	402.8	41	658.1	57	199.3	49	1249.3	34	235.2	32	256.9
21	417.7	46	723.1	48	212.9	41	1961.5	33	243.0	19	263.2
58	427.3	35	733.3	39	214.8	43	1906.4	43	253.5	29	303.9
51	459.0	13	854.3	59	216.4	28	1933.4	62	279.4	11	306.9
17	497.6	22	864.0	36	217.6	20	2001.7	24	279.7	14	312.9
3	505.5	30	879.2	5	232.1	22	2205.2	4	280.0	27	323.7
4	609.9	47	1133.8	33	242.5	30	2666.9	52	287.1	53	336.1
35	651.1	31	1261.4	11	250.7	13	2785.2	41	288.0	59	341.7
40	686.6	3	1425.4	14	252.5	47	3053.2	12	314.4	23	344.3
24	698.2	58	1509.8	19	257.4	3	3070.0	22	340.0	52	346.4
33	727.8	37	1519.5	40	267.4	31	3337.6	50	395.5	51	380.3
34	769.4	21	1523.9	60	286.8	21	3727.1	5	404.2	26	381.5
62	780.4	51	1587.4	51	302.5	4	3767.6	11	419.5	61	382.9
12	784.0	4	1642.4	26	332.1	58	3782.2	59	454.2	21	398.1
8	850.2	7	1695.7	61	342.1	51	4054.3	32	464.9	34	417.3
52	901.0	40	1954.1	52	399.9	12	4131.8	57	471.3	24	434.0
50	958.0	24	1963.0	58	428.0	24	4222.8	39	485.5	40	440.5
39	995.6	12	2047.7	16	429.7	34	4400.5	18	535.1	36	504.8
32	1042.4	33	2109.0	21	431.0	40	4427.7	2	535.3	60	510.8
18	1078.4	34	2114.6	34	438.2	33	4661.1	53	540.6	58	511.7
6	1109.3	62	2159.0	24	482.2	52	4667.3	49	620.2	31	523.1
53	1126.5	52	2331.4	1	535.1	62	4700.9	48	642.6	12	626.8
11	1128.5	39	2449.1	25	544.6	50	5323.4	38	647.9	47	642.6
5	1164.6	50	2476.7	10	557.3	39	5438.0	45	719.6	16	663.6
2	1165.4	32	2546.5	31	567.0	11	5501.0	19	739.6	25	701.3
57	1213.7	53	2608.5	4	602.3	5	5517.7	29	761.2	10	741.8
59	1223.5	18	2658.7	12	670.8	32	5551.3	35	829.7	4	776.4
9	1239.4	11	2715.6	47	719.6	53	5578.3	27	841.3	1	787.3
48	1334.4	2	2764.2	13	762.4	59	5579.5	14	922.7	13	820.0
56	1379.8	5	2785.5	55	767.8	57	5716.6	54	1014.6	30	827.9
45	1383.9	59	2825.0	30	829.3	18	5725.7	61	1096.5	55	922.8
19	1538.5	57	2896.5	42	931.5	2	5815.8	17	1100.6	3	1016.2
29	1598.3	45	3102.3	3	1052.3	48	6154.6	44	1133.8	42	1044.9
27	1675.9	48	3108.3	20	1264.1	45	6290.4	26	1219.6	20	1218.9
54	1827.4	19	3261.5	43	1383.9	19	6445.3	23	1233.9	28	1332.1
14	1873.5	29	3427.8	28	1430.8	29	6496.5	60	1618.0	43	1334.4
46	1906.4	27	3467.8	22	1436.5	27	6819.5	36	1653.4	22	1453.8
61	2000.9	54	3826.8	15	1454.1	14	7004.5	8	1675.6	41	1495.9
23	2095.6	14	3846.7	41	1622.0	54	7291.1	16	1757.7	15	1653.7
26	2325.9	61	4023.6	38	2217.4	61	7299.7	25	1974.5	38	2253.1
36	2596.6	23	4160.7	49	2252.9	23	7856.1	6	2020.1	49	2287.1
60	2661.8	26	4453.0	35	2762.8	26	7980.8	9	2237.5	35	2688.8
37	2959.1	36	4792.1	44	3102.3	60	8684.6	10	2254.0	44	3108.3
16	2964.9	60	4921.6	17	3168.0	36	8703.5	1	2308.7	17	3212.6
25	3027.4	16	5307.7	8	4031.2	16	9241.7	56	2382.2	8	4078.0
10	3433.0	25	5320.6	9	4538.7	25	9542.6	55	2567.6	6	4583.3
1	3460.1	1	5957.9	6	4847.4	10	10180.7	42	2774.9	9	5003.4
7	3515.4	10	5966.6	56	5274.4	1	10309.8	46	3053.2	56	5045.8
55	3974.1	55	6713.6	46	6290.4	55	11114.7	15	3699.8	46	6154.6
42	4202.3	42	6976.7	37	8135.5	42	11442.2	37	4362.1	37	7736.7
15	5397.2	15	8545.8	7	9121.3	15	13289.5	7	5092.5	7	8886.4

	49		50		51		52		53		54
35	131.3	32	59.2	58	69.2	34	48.9	32	46.5	23	108.5
22	194.3	18	64.3	40	75.0	5	95.0	45	79.5	45	137.7
28	235.4	45	80.0	31	89.8	62	109.4	2	84.1	60	149.2
38	248.6	62	91.1	50	111.7	33	113.7	50	102.3	48	152.0
20	272.9	57	95.0	21	116.9	59	123.2	62	135.3	14	152.3
41	276.2	40	100.1	33	130.5	57	138.9	18	141.7	61	154.8
43	319.3	2	100.4	62	148.4	24	139.5	29	167.5	29	170.6
8	365.5	53	102.3	32	153.3	12	144.3	39	170.5	2	174.1
17	405.5	33	104.5	47	160.4	11	150.0	33	175.3	18	200.0
44	414.0	51	111.7	18	169.5	40	179.6	59	181.9	26	201.5
30	440.3	59	115.1	13	180.9	21	206.5	40	198.4	36	204.9
3	513.5	5	127.2	39	209.3	50	214.5	11	204.5	57	233.9
13	576.0	11	141.8	53	229.6	31	230.1	57	209.5	50	237.9
47	620.2	29	154.4	2	230.4	29	257.9	27	224.5	32	239.3
6	763.1	39	181.0	34	233.2	58	271.2	51	229.6	37	245.7
31	767.2	48	183.1	4	233.9	51	275.4	5	243.3	19	254.3
4	794.5	58	190.5	30	238.3	47	287.1	19	245.0	16	266.8
9	837.6	21	210.1	11	268.8	4	299.2	54	277.7	53	277.7
21	839.6	52	214.5	5	271.7	3	301.3	14	304.0	10	293.0
58	854.9	34	214.6	52	275.4	14	306.1	58	320.4	39	293.1
56	875.8	54	237.9	59	280.9	2	308.8	23	334.3	11	294.8
12	964.7	27	245.9	57	282.2	32	333.9	48	336.1	5	317.1
24	1015.4	19	286.6	24	282.7	53	345.7	21	339.3	33	325.8
34	1078.1	24	292.5	45	302.5	48	346.4	34	341.2	1	327.0
51	1086.1	31	293.6	12	351.3	45	399.9	52	345.7	62	337.4
40	1209.9	23	295.3	48	380.3	18	406.9	24	353.7	59	341.7
46	1249.3	14	303.9	3	424.8	30	407.0	61	387.5	25	349.7
52	1287.0	4	343.5	20	427.8	39	416.0	26	403.2	55	503.7
62	1291.5	61	377.7	29	450.7	19	430.8	4	413.8	52	516.8
33	1308.8	12	379.2	27	451.5	61	441.0	31	418.8	24	554.5
50	1664.5	47	395.5	19	455.7	27	507.0	60	438.5	34	563.7
11	1691.1	26	440.3	43	459.0	54	516.8	36	439.0	40	563.9
59	1722.7	36	462.3	28	499.4	13	527.6	13	530.2	42	565.6
5	1760.5	13	495.9	54	570.7	26	582.5	47	540.6	51	570.7
57	1789.5	60	521.2	22	592.7	20	624.1	16	552.6	21	629.1
53	1814.0	30	533.0	14	643.1	28	705.4	12	581.6	58	714.0
32	1849.4	3	621.6	23	656.3	22	719.9	30	591.0	12	799.1
39	1949.2	16	655.4	41	721.3	23	749.4	25	680.9	31	846.8
2	1963.6	25	813.8	61	746.5	41	779.3	10	771.2	4	911.0
18	2036.8	20	850.5	26	936.6	60	820.0	1	788.9	47	1014.6
37	2124.6	10	889.6	36	927.9	43	901.0	3	870.8	15	1044.0
29	2196.1	1	895.4	38	989.7	16	981.9	20	988.7	30	1165.2
45	2252.9	28	953.9	60	1037.0	36	1006.5	55	1075.6	13	1179.1
48	2287.1	43	958.0	49	1086.1	49	1287.0	43	1126.5	3	1339.2
19	2482.7	23	962.3	16	1191.3	10	1336.5	28	1149.3	20	1722.3
14	2525.2	55	1103.0	25	1275.1	25	1385.8	42	1173.6	43	1827.4
61	2650.1	41	1183.1	35	1497.1	35	1425.0	22	1182.2	22	1853.8
27	2673.1	42	1293.0	1	1501.7	1	1479.5	41	1247.1	26	1870.0
7	2728.7	49	1664.5	10	1519.8	38	1578.2	38	1811.2	41	2058.2
54	2809.9	38	1698.9	44	1587.4	55	1596.8	49	1814.0	49	2809.9
23	3140.0	15	1875.8	17	1674.3	42	1698.9	15	1868.6	38	2839.3
26	3255.4	35	2093.1	55	1815.3	17	2250.7	35	2289.2	35	3312.3
60	3565.9	44	2476.7	42	2020.5	15	2330.7	44	2608.5	44	3826.8
36	3742.1	17	2554.7	8	2335.4	44	2331.4	17	2629.9	17	3966.0
16	3954.7	8	3272.1	15	2818.6	8	2833.0	8	3503.2	8	4860.7
25	4398.7	6	3987.0	6	2985.2	5	3431.8	9	4246.3	6	5513.8
10	4615.3	9	4019.8	9	2904.1	9	3732.9	6	4252.6	9	5898.5
1	4778.3	56	4350.3	56	3247.9	56	3778.1	56	4740.7	56	6146.5
55	5283.3	46	5323.4	46	4054.3	46	4667.3	46	5578.3	46	7291.1
42	5506.0	37	7024.2	37	5598.2	37	6103.8	37	7390.7	37	9080.5
15	6695.9	7	7976.8	7	6347.6	7	7192.4	7	8231.6	7	10278.8

	55		56		57		58		59		60
42	78.7	6	128.9	11	34.6	51	69.2	5	38.1	10	98.4
1	124.6	46	146.5	59	39.4	40	97.9	57	39.4	16	115.4
10	137.4	8	200.8	5	53.9	21	108.4	11	47.3	36	143.8
16	156.9	9	283.4	29	84.8	31	110.5	29	93.1	54	149.2
15	177.7	37	414.3	50	95.0	47	129.1	50	115.1	1	165.9
25	255.7	44	569.1	34	119.4	4	147.4	52	123.2	61	175.0
60	288.3	17	576.4	2	125.1	34	149.1	40	128.4	23	180.6
36	293.7	7	748.9	33	128.0	62	169.0	34	129.6	14	192.1
26	357.3	38	844.9	14	137.3	33	171.7	62	151.9	29	212.3
23	361.5	49	875.8	62	138.3	13	174.2	32	157.9	26	224.9
54	503.7	35	882.9	52	138.9	50	190.5	2	165.8	45	286.8
14	630.9	28	1377.5	32	160.4	30	215.7	14	170.3	55	288.3
27	644.1	43	1379.8	40	175.7	12	222.2	33	173.1	42	312.3
61	649.3	41	1439.5	61	190.6	24	237.3	53	181.9	25	348.2
29	733.4	20	1494.3	45	199.2	11	260.4	45	216.4	2	418.2
45	767.8	22	1537.0	53	209.5	32	263.3	27	247.9	27	424.6
19	815.1	30	2084.8	18	318.4	3	265.2	18	271.3	53	438.5
2	920.0	13	2198.4	48	224.2	52	271 2	19	276.9	57	451.8
48	922.8	3	2330.9	54	233.9	57	272.0	61	280.9	19	485.2
57	973.6	47	2382.2	24	247.6	59	281.2	51	280.9	32	499.1
18	982.6	31	2631.6	12	264.3	5	300.4	58	281.2	59	506.6
32	1015.9	21	2907.9	27	266.9	18	316.0	12	291.7	48	510.8
59	1056.9	58	2964.3	58	272.0	53	320.4	24	300.5	50	521.2
5	1068.7	4	2992.6	19	279.5	2	327.2	26	309.8	18	527.1
53	1075.6	12	3223.5	51	282.2	28	365.0	54	341.7	11	530.3
11	1090.4	51	3247.9	26	291.8	22	367.3	48	341.7	5	562.2
50	1103.0	24	3400.9	23	299.8	20	380.8	39	344.7	15	613.7
39	1192.0	34	3519.0	39	310.6	39	389.4	4	350.4	62	628.0
62	1447.7	40	3591.3	21	313.5	43	427.3	21	357.8	39	680.6
33	1453.8	52	3778.1	4	387.6	45	428.0	31	377.2	33	693.1
40	1595.3	33	3725.4	31	398.6	29	469.3	23	390.3	52	820.0
52	1596.8	62	3826.8	60	451.8	48	511.7	47	454.2	34	880.6
34	1707.0	50	4350.3	47	471.3	41	598.6	60	506.6	40	896.5
51	1815.3	5	4556.5	16	512.1	19	616.5	3	512.4	24	908.1
24	1912.7	11	4576.2	3	550.4	27	633.9	16	537.8	51	1037.0
58	2013.6	39	4584.7	36	557.9	14	670.5	36	614.9	21	1098.3
12	2094.8	59	4642.1	30	676.5	54	714.0	30	664.0	12	1146.8
21	2096.2	32	4671.4	13	713.9	61	755.1	13	683.0	58	1153.0
4	2256.7	57	4698.0	25	812.4	23	773.9	25	900.5	4	1228.0
31	2305.7	18	4731.5	10	814.3	49	854.9	10	915.8	31	1402.4
47	2567.6	53	4740.7	1	906.6	38	920.5	20	962.8	47	1618.0
13	2869.1	2	4898.7	55	973.6	26	969.3	1	993.6	30	1758.0
3	2921.2	48	5045.8	22	1021.8	36	1133 4	22	1016.5	13	1776.5
30	2968.2	45	5274.4	30	1024.5	60	1153.0	28	1026.0	3	1841.9
20	3726.7	29	5454.8	28	1065.2	35	1198.8	55	1056.9	20	2434.3
22	3859.9	19	5518.0	42	1115.6	16	1324.1	41	1192.4	22	2454.9
28	3881.5	27	5863.0	43	1213.7	44	1509.8	42	1201.7	28	2616.9
43	3974.1	14	5929.7	41	1274.5	25	1528.7	43	1223.5	43	2561.8
41	4164.0	54	6146.5	15	1616.2	17	1563.8	15	1714.7	41	2759.2
49	5283.3	61	6171.9	49	1789.5	10	1719.6	49	1722.7	49	3565.9
38	5377.2	23	6659.1	38	2038.2	1	1756.0	35	1965.0	38	3775.7
35	5809.7	26	6896.5	35	2076.6	55	2013.6	38	1982.3	35	4070.8
44	6713.6	36	7473.6	44	2896.5	8	2075.6	17	2752.6	44	4931.6
17	6752.3	60	7480.9	17	2902.4	42	2257.8	44	2825.0	17	4994.8
8	8062.4	16	8076.5	8	3591.9	9	2677.2	8	3496.5	8	5922.9
6	9059.8	25	8386.7	6	4309.5	6	2681.3	6	4240.0	6	6955.0
9	9186.1	10	8884.8	9	4483.3	56	2964.3	9	4319.7	9	7092.5
56	9699.5	1	9021.1	56	4698.0	15	3016.1	56	4642.1	56	7480.9
46	11114.7	55	9699.5	46	5716.6	46	3782.2	46	5579.5	46	8684.6
37	13457.7	42	10092.2	37	7403.7	37	5274.5	37	7320.8	37	10594.9
7	14750.6	15	11700.6	7	8475.4	7	6049.2	7	8307.5	7	11986.3

	61		62
14	67.8	33	34.0
29	141.0	21	82.9
54	154.8	24	89.9
60	175.0	50	91.1
57	190.6	52	109.4
26	211.9	34	111.1
11	224.5	53	135.3
23	247.3	57	138.3
2	254.2	51	148.4
59	280.9	59	151.9
16	280.9	40	153.9
5	318.8	5	160.4
45	342.1	32	163.1
33	373.8	11	165.9
19	377.6	58	169.0
50	377.7	2	171.1
48	382.9	29	186.4
62	386.7	45	189.6
53	387.5	18	203.3
10	397.7	31	207.6
27	403.9	48	237.7
32	407.6	39	242.1
34	431.3	12	243.3
36	439.2	4	251.4
52	441.0	47	279.4
24	457.9	14	290.7
18	478.5	30	309.6
39	530.5	54	337.4
1	556.2	13	359.5
25	571.4	19	363.9
12	585.8	61	386.7
40	620.9	27	435.7
42	633.6	3	465.8
55	649.3	23	544.5
21	707.4	26	574.4
51	746.5	20	609.5
58	755.1	60	628.0
4	780.0	22	714.2
31	946.4	28	728.1
15	1059.1	36	732.5
47	1096.5	43	780.4
3	1158.4	41	805.6
30	1233.1	16	864.0
13	1337.2	10	1088.0
22	1703.1	25	1121.6
20	1805.1	1	1181.8
28	1876.6	49	1391.5
43	2000.9	38	1427.5
41	2016.0	55	1447.7
49	2650.1	42	1563.8
38	2996.5	35	1628.5
35	3002.5	44	2159.0
44	4023.6	17	2183.0
17	4100.8	15	2265.2
8	4824.4	8	2800.6
6	5678.8	6	3455.1
9	6004.6	9	3658.6
56	6171.9	56	3826.8
46	7299.7	46	4700.8
37	9049.5	37	6208.4
7	10334.1	7	7235.0

APENDIX 13

COMPUTER PROGRAMMES (BASIC) USED FOR THE ANALYSIS

The computer programmes appended here are specifically written for the analysis of the present study using Versa-IWS system installed at the College of Veterinary and Animal Sciences, Mannuthy.

The first program - Program for Analysis of Dispersion - will split the total dispersion into componeents and the 'within' and 'between' dispersions will store in files "ERORCOV" and "BETCOV" respectively. The variety means will save in the file "VTYMEANS". Further the genotypic covariances can also be estimated and stored in the file "GENOCOV".

The second program is intended for withdrawing the rows and columns of a symmetric matrix. The third program can be used for either Principal Component Analysis or Principal Factor Analysis. When the program is 'run' for PFA, it can be stopped at any stage of the iteration; the 'reduced correlation matrix' obtained for the previous iteration will be stored in 'CURRENT'. The remaining iterations can be carried out by inputing "CURRENT", when the machine asks "FA CORRLN MATRIX FILE NAME".

The D-square values are computed by the execution of three programmes - Program 4, 5, and 6. The program 7 was used for inverting the 'V-matrix'.

```
5   REM  PROGRAM FOR ANALYSIS OF DISPERSION
10  DIM X(30,200),S(30),R(30,3),Y(30,70),T(30,30)
20  DIM D(30,30),B(30,30),W(30,30)
30  INPUT "NO OF VARIABLES";P
40  INPUT "NO OF TREATMENTS";V
50  INPUT "NO OF REPLICATIONS";Q
60  INPUT "DATA FILE NAME";F$
70  INPUT "TITLE";T$
80  FOR I=1 TO P
90  S(I)=0
100 FOR J=1 TO Q
110 R(I,J)=0
120 NEXT J:NEXT I
130 OPEN "I",#1,F$
140 A=V*Q
150 FOR I=1 TO P
160 C=0
170 L=0
180 B=0
190 FOR J=1 TO A
200 INPUT #1,X(I,J)
210 C=C+1
220 S(I)=S(I)+X(I,J)
230 R(I,C)=R(I,C)+X(I,J)
240 B=B+X(I,J)
250 IF C=Q THEN 270
260 GOTO 310
270 C=0
280 L=L+1
290 Y(I,L)=B
300 B=0
310 NEXT J
320 NEXT I
330 FOR I=1 TO P
340 FOR J=I TO P
350 T(I,J)=0:B(I,J)=0:D(I,J)=0
360 FOR K=1 TO A
370 T(I,J)=T(I,J)+X(I,K)*X(J,K)
380 NEXT K
390 FOR K=1 TO V
400 B(I,J)=B(I,J)+Y(I,K)*Y(J,K)
410 NEXT K
420 FOR K=1 TO Q
430 D(I,J)=D(I,J)+R(I,K)*R(J,K)
440 NEXT K
450 T(I,J)=T(I,J)-S(I)*S(J)/A
460 B(I,J)=B(I,J)/Q-S(I)*S(J)/A
470 D(I,J)=D(I,J)/V-S(I)*S(J)/A
480 W(I,J)=T(I,J)-B(I,J)-D(I,J)
490 NEXT J
500 NEXT I
```

```
510 FOR I=1 TO P
520 FOR J=I TO P
530 W(I,J)=W(I,J)/((Q-1)*(V-1))
540 B(I,J)=B(I,J)/(V-1)
560 NEXT J: NEXT I
570 FOR I=1 TO P
580 FOR J=1 TO V
590 Y(I,J)=Y(I,J)/Q
600 NEXT J: NEXT I
660 V$="VTYMEANS": W$="ERORCOV": B$="BETCOV"
680 OPEN "O",#2,B$: OPEN "O",#3,W$
690 FOR I=1 TO P: FOR J=I TO P
700 PRINT#2,B(I,J)
705 PRINT #3,W(I,J)
710 NEXT J: NEXT I
720 CLOSE 2: CLOSE 3
770 OPEN "O",#2,V$
780 FOR I=1 TO P: FOR J=1 TO V
790 PRINT #2,Y(I,J)
800 NEXT J: NEXT I
810 CLOSE 2
820 FOR I=1 TO P:FOR J=I TO P
830 D(I,J)=(B(I,J)-W(I,J))/Q
840 NEXT J:NEXT I
850 GG$="GENOCOV"
860 OPEN "O",#3,GG$
870 FOR I=1 TO P:FOR J=I TO P
880 PRINT #3,D(I,J)
890 NEXT J:NEXT I
900 CLOSE 3
910 STOP
920 END
```

```
5    REM  PROGRAM FOR REDUCING A SQUARE MATRIX
10   DIM A(30,30),B(30,30)
20   INPUT "VAR. MAT. FILE";F$
30   INPUT "NO OF VARIABLES";P
35   INPUT "REDUCED MATRIX SAVING FILE";T$
40   OPEN "I",#1,F$
50   FOR I=1 TO P:FOR J=I TO P
60   INPUT #1,A(I,J) : NEXT J: NEXT I
70   INPUT "DELETING COLUMN";K
80   P1 = P-1
85   T=0
90   FOR I=1 TO P1 : FOR J=I TO P1
100 IF J >= K THEN 120
110 B(I,J)=A(I,J) : GOTO 170
120 IF I >= K THEN 140
130 B(I,J)=A(I,J+1) : GOTO 170
140 B(I,J)=A(I+1,J+1)
170 NEXT J:NEXT I
175 T=T+1
180 INPUT "NEXT COL.NO. TO BE DELETED 0 FOR STOP";K
190 IF K = 0 THEN 220
195 FOR I=1 TO P1 : FOR J=I TO P1
196 A(I,J)=B(I,J):NEXT J : NEXT I
197 K=K-T
200 P1=P1-1
210 GOTO 90
220 OPEN "O",#2,T$
240 FOR I=1 TO P1 : FOR J=I TO P1
250 PRINT #2,B(I,J) : NEXT J: NEXT I
260 CLOSE 2
270 STOP
280 END
```

```
5   REM PROGRAM FOR PRINCIPAL COMPONENT/FACTOR ANALYSIS
10 DIM R(30,30),A(30,30),D(20,20),V(30,30),E(20,30)
11 DIM D1(30,30),D2(30,30),P(30),MM(30),C(30,20),B(30)
12 REM  FA COR. MAT. MEANS THE COR. MAT. WITH
13 REM  INITIAL COMMUNALITIES IN THE DIAGONAL
14 INPUT "FA CORLN MATRIX FILE NAME";F$
15 INPUT "ORDER OF FA CORLN MATRIX";N
20 INPUT "ORIGINAL CORLN MATRIX";R$
21 INPUT "FOR PCA, GIVE 1";Z5
22 IF Z5 <> 1 THEN 25
23 M=N: IMAX=1
24 GOTO 37
25 OPEN"I",#1,F$
30 FOR I=1 TO N: FOR J=1 TO N
35 INPUT #1,A(I,J) : NEXT J: NEXT I
37 OPEN "I",#2,R$
40 FOR I=1 TO N: FOR J=I TO N
45 INPUT #2,R(I,J) : NEXT J:NEXT I
46 FOR J=1 TO N: FOR I=1 TO J
47 R(J,I)=R(I,J) : NEXT I: NEXT J
48 IF Z5 = 1 THEN 107
50 INPUT "MINIMUM NO OF FACTORS REQUIRED";M
60 INPUT "MAXIMUM ITEERATIONS REQUIRED";IMAX
70 FOR I=1 TO N : FOR J=1 TO N
80 IF I <> J THEN 90
85 D1(I,J)=1 : GOTO 95
90 D1(I,J)=0
95 NEXT J: NEXT I
100 INPUT "PREVIOUS ITRN";ITRN
105 ITRN=ITRN+1
106 GOTO 110
107 FOR I=1 TO N:FOR J=1 TO N
108 A(I,J)=R(I,J):NEXT J:NEXT I
110 SW=1
140 IF SW=0 THEN 220
150 FOR I=1 TO N: FOR J=1 TO N
160 IF I<>J THEN 200
170 V(I,J)=1
190 GOTO 210
200 V(I,J)=0
210 NEXT J: NEXT I
220 NR=0
230 MI=N-1
240 FOR I=1 TO MI
250 P(I)=0
260 MJ=I+1
270 FOR J=MJ TO N
280 IF P(I)>ABS(A(I,J)) THEN 310
290 P(I)=ABS(A(I,J))
300 MM(I)=J
310 NEXT J: NEXT I
320 FOR I=1 TO MI
330 IF I <= 1 THEN 350
340 IF PMAX >P(I) THEN 380
350 PMAX=P(I)
```

```
360 IP=I
370 JP=MM(I)
380 NEXT I
390 IF NR=0 THEN EPLN=ABS(PMAX)*.000000001#
400 IF PMAX <= EPLN THEN 1230
410 NR=NR+1
420 IF A(IP,IP) >=A(JP,JP) THEN 450
430 TN = -2*A(IP,JP)/(ABS(A(IP,IP)-A(JP,JP))+
     SQR((A(IP,IP)-A(JP,JP))^2+4*A(IP,JP)^2))
440 GOTO 460
450 TN = 2*A(IP,JP)/(ABS(A(IP,IP)-A(JP,JP))+
     SQR((A(IP,IP)-A(JP,JP))^2+4*A(IP,JP)^2))
460 CS=1!/SQR(1+TN^2)
470 SN=TN*CS
480 AI=A(IP,IP)
490 A(IP,IP)=CS^2*(AI+TN*(2*A(IP,JP)+TN*A(JP,JP)))
500 A(JP,JP)=CS^2*(A(JP,JP)-TN*(2*A(IP,JP)-TN*AI))
510 A(IP,JP)=0
520 IF A(IP,IP) >= A(JP,JP) THEN 620
530 TT = A(IP,IP)
540 A(IP,IP)=A(JP,JP)
550 A(JP,JP)=TT
560 IF SN >= 0 THEN 590
570 TT=CS
580 GOTO 600
590 TT = -CS
600 CS = ABS(SN)
610 SN = TT
620 FOR I=1 TO MI
630 IF SGN(I-IP)= -1 THEN 660
640 IF SGN(I-IP)=0 THEN 790
650 IF I=JP THEN 790
660 IF MM(I)=IP THEN 680
670 IF MM(I) <> JP THEN 790
680 K=MM(I)
690 TT = A(I,K)
700 A(I,K)=0
710 MJ = I+1
720 P(I)=0
730 FOR J=MJ TO N
740 IF P(I) > ABS(A(I,J)) THEN 770
750 P(I)=ABS(A(I,J))
760 MM(I)=J
770 NEXT J
780 A(I,K)=TT
790 NEXT I
800 P(IP)=0
810 P(JP)=0
820 FOR I=1 TO N
830 IF SGN(I-IP)=0 THEN 1150
840 IF SGN(I-IP)=1 THEN 950
850 TT=A(I,IP)
```

```
860 A(I,IP)=CS*TT+SN*A(I,JP)
870 IF P(I) >= ABS(A(I,IP)) THEN 900
880 P(I)=ABS(A(I,IP))
890 MM(I)=IP
900 A(I,JP)=-SN*TT+CS*A(I,JP)
910 IF P(I) >= ABS(A(I,JP)) THEN 1150
920 P(I)=ABS(A(I,JP))
930 MM(I)=JP
940 GOTO 1150
950 IF SGN(I-JP)=-1 THEN 980
960 IF SGN(I-JP)=0 THEN 1150
970 IF SGN(I-JP)=1 THEN 1060
980 TT=A(IP,I)
990 A(IP,I)=CS*TT+SN*A(I,JP)
1000 IF P(IP) >= ABS(A(IP,I)) THEN 1030
1010 P(IP)=ABS(A(IP,I))
1020 MM(IP)=I
1030 A(I,JP)=-TT*SN + CS*A(I,JP)
1040 IF P(I)>=ABS(A(I,JP)) THEN 1150
1050 GOTO 920
1060 TT= A(IP,I)
1070 A(IP,I)=TT*CS+SN*A(JP,I)
1080 IF P(IP) >= ABS(A(IP,I)) THEN 1110
1090 P(IP)=ABS(A(IP,I))
1100 MM(IP)=I
1110 A(JP,I)=-TT*SN+CS*A(JP,I)
1120 IF P(JP) >=ABS(A(JP,I)) THEN 1150
1130 P(JP)=ABS(A(JP,I))
1140 MM(JP)=I
1150 NEXT I
1160 IF SW = 0 THEN 320
1170 FOR I= 1 TO N
1180 TT=V(I,IP)
1190 V(I,IP)=TT*CS+SN*V(I,JP)
1200 V(I,JP)=-TT*SN+CS*V(I,JP)
1210 NEXT I
1220 GOTO 320
1230 FOR I=1 TO N
1240 B(I)=A(I,I)
1250 NEXT I
1260 IF Z5 <> 1 THEN 1340
1270 OPEN "O",#3,"LVECTOR"
1280 FOR I=1 TO N:FOR J=1 TO N
1290 PRINT #3,V(I,J):NEXT J:NEXT I
1300 CLOSE 3
1310 OPEN "O",#3,"LROOTS"
1320 FOR I=1 TO N:PRINT #3,B(I):NEXT I
1330 CLOSE 3
1335 GOTO 3000
1340 FOR I=1 TO M : FOR J=1 TO M
1350 IF I <> J THEN 1370
1360 D(I,J)=B(I) : GOTO 1380
1370 D(I,J)=0
1380 NEXT J: NEXT I
```

```
1390 FOR I=1 TO M : FOR J=1 TO N
1400 E(I,J)=V(J,I) : NEXT J: NEXT I
1410 FOR I=1 TO N : FOR J= 1 TO M
1420 C(I,J)=0 : FOR K=1 TO M
1430 C(I,J)=C(I,J)+V(I,K)*D(K,J)
1440 NEXT K : NEXT J:NEXT I
1450 FOR I=1 TO N : FOR J=1 TO N
1460 D2(I,J)=0 : FOR K=1 TO M
1470 D2(I,J)=D2(I,J)+C(I,K)*E(K,J)
1480 NEXT K: NEXT J:NEXT I
1490 FOR I=1 TO N: FOR J=1 TO N
1500 IF I <> J THEN 1520
1510 A(I,J)=D2(I,J) : GOTO 1530
1520 A(I,J)=R(I,J)
1530 NEXT J: NEXT I
1540 SS=0
1550 FOR I=1 TO N : FOR J=1 TO N
1560 A(I,J)=A(I,J)-D2(I,J)
1570 SS=SS+A(I,J)*A(I,J): NEXT J: NEXT I
1580 LPRINT "TRACE OF SQUIRED DIFF.MAT.FOR THE ";
1585 LPRINT ITRN;"TH ITERATION ";SS
1590 EPSLN=9.999999E-06
1595 FOR I=1 TO N : FOR J=1 TO N
1600 IF I <> J THEN 1630
1610 DIF = ABS(D1(I,J)-D2(I,J))
1620 IF DIF > EPSLN THEN 1650
1630 NEXT J: NEXT I
1640 GOTO 1840
1650 ITRN=ITRN+1
1655 IF ITRN > IMAX THEN 1840
1656 FOR I=1 TO N:FOR J=1 TO N
1660 IF I <> J THEN 1680
1670 A(I,J) =D2(I,J) : GOTO 1690
1680 A(I,J)=R(I,J)
1690 NEXT J: NEXT I
1700 FOR I=1 TO N : FOR J=1 TO N
1710 IF I <> J THEN 1730
1720 D1(I,J)=D2(I,J)
1730 NEXT J: NEXT I
1790 OPEN"O",#3,"CURRENT"
1800 FOR I=1 TO N : FOR J=1 TO N
1810 PRINT #3,A(I,J):NEXT J: NEXT I
1820 CLOSE 3
1825 PRINT ITRN;"TH ITERATION STARTED"
1830 GOTO 110
1840 FOR I=1 TO M : FOR J=1 TO M
1850 IF SGN(B(I)) = -1 THEN 1880
1860 NEXT J: NEXT I
1870 GOTO 1910
1880 M=M+1
1890 IF M > 20 THEN 3000
1895 PRINT"UNSATISFIED NO. OF FACTORS.";
1896 PRINT "ITERATION STARTED FORM 1"
1900 GOTO 110
```

```
1910 LPRINT "FINAL RESULTS OF FCA"
1920 LPRINT
1930 LPRINT "NO. OF ITERATIONS TAKEN";ITRN-1
1940 LPRINT "NO. OF FACTORS "; M
1950 LPRINT
1960 FOR I=1 TO M : FOR J=1 TO M
1970 IF I <> J THEN 1990
1980 D(I,J)=SQR(B(I)) : GOTO 2000
1990 D(I,J)=0
2000 NEXT J: NEXT I
2010 FOR I=1 TO N : FOR J=1 TO M
2020 A(I,J)=0 : FOR K=1 TO M
2030 A(I,J)=A(I,J)+V(I,K)*D(K,J) : NEXT K:NEXT J:NEXT I
2040 OPEN"O",#3,"FLOADINGS"
2050 FOR I=1 TO N : FOR J=1 TO M
2060 PRINT #3,A(I,J) : NEXT J: NEXT I : CLOSE 3
2070 LPRINT:LPRINT
2075 LPRINT "FACTOR LOADINGS WERE SAVED IN   FLOADING "
2076 LPRINT
2105 LPRINT "-------------------------------------------"
2106 LPRINT
2110 LPRINT "D1 MAT. (PREVIOUS)";TAB(40);"D2 MAT. (NEW)"
2115 LPRINT"----------------------------------------";
2120 FOR I=1 TO N : FOR J=1 TO N
2130 IF I <> J THEN 2150
2140 LPRINT TAB(10);D1(I,J);TAB(53);D2(I,J)
2150 NEXT J: NEXT I
2155 LPRINT"----------------------------------------";
2160 OPEN"O",#3,"FINALRT"
2170 FOR I=1 TO N : PRINT #3,B(I) : NEXT I
2180 CLOSE 3
3000 STOP
3010 END
```

4

```
10  REM  COMPUTATION OF DSOUARE VALUES - 1
11  REM  THIS PROGRAM WILL TRANSFORM THE X-MEANS
12  REM  TO Y-MEANS.  THE LOWER TRIANGULAR
13  REM  MATRIX USED FOR THE TRANSFORMATION
14  REM  IS REFERED AS V-MATRIX.
17  DIM V(30,30),B(30,30),VN(30)
18  DIM A(30,30),X(30,62),Y(30,62)
20  INPUT "NO OF VARIABLES "; P
30  INPUT "COVARIANCE MATRIX FILE";V$
40  INPUT "NO OF GENOTYPES";N
50  INPUT "ORIGINAL MEANS FILE";X$
60  INPUT "Y MEANS SAVING FILE";Y$
70  INPUT "V-MATRIX SAVING FILE";GG$
90  OPEN"I",#1,X$
100 FOR I=1 TO P:FOR J=1 TO N
110 INPUT #1,X(I,J) : NEXT J: NEXT I
120 OPEN"I",#2,V$
130 FOR I=1 TO P : FOR J=I TO P
140 INPUT #2,V(I,J) : NEXT J : NEXT I
150 FOR J=1 TO P : FOR I=1 TO J
160 V(J,I)=V(I,J) : NEXT I : NEXT J
170 FOR I=1 TO P : FOR J=1 TO P
180 IF I=J THEN 210
190 B(I,J)=0
200 GOTO 220
210 B(I,J)=1
220 NEXT J : NEXT I
230 K=1
240 VN(K)=V(K,K): V=V(K,K)
250 FOR J=1 TO K : A(K,J)=B(K,J):NEXT J
260 FOR J=1 TO P
270 V(K,J)=V(K,J)/V
280 B(K,J)=B(K,J)/V
290 NEXT J
300 FOR I=K+1 TO P
310 V=V(I,K) : FOR J=1 TO P
320 V(I,J)=V(I,J)-V*V(K,J)
330 NEXT J:NEXT I
340 FOR I=K TO P:V(I,K)=V(K,I):NEXT I
370 FOR I=K+1 TO P:FOR J=1 TO K
390 B(I,J)=-V(I,J)
400 NEXT J : NEXT I
410 K=K+1
420 IF K <= P THEN 240
430 FOR I=1 TO P : Z=SQR(VN(I))
440 FOR J=1 TO I
450 A(I,J)=A(I,J)/Z
460 NEXT J: NEXT I
```

```
470 FOR I=1 TO P : FOR J=1 TO N
480 Y(I,J)=0
490 FOR K=1 TO I
500 Y(I,J)=Y(I,J)+A(I,K)*X(K,J)
510 NEXT K: NEXT J: NEXT I
515 OPEN"O",#3,Y$
520 FOR I=1 TO P : FOR J=1 TO N
530 PRINT #3, Y(I,J) : NEXT J:NEXT I
535 CLOSE 3
540 OPEN "O",#3,GG$
550 FOR I=1 TO P:FOR J=1 TO I
560 INPUT #3,A(I,J)
570 NEXT J:NEXT I:CLOSE 3
580 END
```

5

```
10  REM   COMPUTATION OF D-SQUARE VALUES - 2
11  REM  THIS PROGRAM WILL COMPUTE THE
12  REM  D-SQUARE VALUES, PROVIDED THE
13  REM  Y-VARIABLES ARE UNIVARIATE
14  REM  UNCORRELATED VARIABLES.
20  DIM Y(30,62),D(62,62)
30  PRINT "WRITTEN BY MURALI ON 15TH JAN 1986"
40  INPUT "NO OF VARIABLES";P
50  INPUT "NO OF POPULATION";N
60  INPUT "Y MEANS FILE";Y$
70  INPUT "D2 SAVING FILE";D$
80  OPEN"I",#1,Y$
90  FOR I=1 TO P : FOR J=1 TO N
100 INPUT #1,Y(I,J) : NEXT J: NEXT I
110 FOR I=1 TO N : FOR J=I+1 TO N
120 D(I,J)=0
130 FOR K=1 TO P
140 D(I,J)=D(I,J)+(Y(K,I)-Y(K,J))*(Y(K,I)-Y(K,J))
150 NEXT K : NEXT J: NEXT I
155 OPEN"O",#2,D$
160 FOR I=1 TO N : FOR J=I+1 TO N
170 PRINT #2, D(I,J) : NEXT J: NEXT I
180 CLOSE 2
190 STOP
200 END
```

6

```
10  REM  COMPUTATION OF D-SQUARE VALUES - 3
11  REM  THIS PROGRAM WILL ARRANG THE D-SQUARE
12  REM  VALUES IN ASENDING ORDER OF MAGNITUDE.
20  DIM D(62,62),A(62,62)
30  PRINT "WRITTEN BY MURALI ON 15 JAN 1986"
40  INPUT "D2 VALUES FILE";D$
50  INPUT "NO. OF POPULATIONS";N
60  INPUT "TITLE TO BE PRINT";T$
70  OPEN"I",#1,D$
80  FOR I=1 TO N : FOR J=I+1 TO N
90  INPUT #1,D(I,J): NEXT J:NEXT I
100 FOR J=1 TO N : FOR I=1 TO J
110 IF I=J THEN 140
120 D(J,I)=D(I,J)
130 GOTO 150
140 D(I,J)=0
150 NEXT I : NEXT J
160 FOR I=1 TO N: FOR J=1 TO N
170 A(I,J)=I : NEXT J : NEXT I
180 K=1
190 H=1
200 FOR I=H TO N
210 IF D(H,K) <= D(I,K) THEN 250
220 D=D(H,K): B=A(H,K)
230 D(H,K)=D(I,K) : A(H,K)=A(I,K)
240 D(I,K)=D : A(I,K)=B
250 NEXT I
260 H=H+1
270 IF H < N THEN 200
280 K=K+1
290 IF K > N THEN 310
300 GOTO 190
310 A$="#####.#": B$="##"
320 LPRINT TAB(50);T$ : LPRINT : LPRINT:LPRINT
325 K=0
330 FOR I=1 TO N :E=8 : C=12 : FOR J=K+1 TO K+8
335 IF I <> 1 THEN 340
336 LPRINT TAB(C+2):LPRINT USING B$;J;
337 GOTO 355
340 LPRINT TAB(E): LPRINT USING B$;A(I,J);
350 LPRINT TAB(C):LPRINT USING A$;D(I,J);
355 E=E+12 : C=C+12
360 NEXT J:LPRINT
362 NEXT I
370 INPUT G
375 IF G=0 THEN 450
380 K=K+8
390 IF K=56 THEN 410
400 GOTO 330
```

```
410 FOR I=1 TO N :E=5 : C=12 : FOR J=57 TO 62
415 IF I <> 1 THEN 420
416 LPRINT TAB(C+2):LPRINT USING B$;J;
417 GOTO 435
420 LPRINT TAB(E): LPRINT USING B$;A(I,J);
430 LPRINT TAB(C): LPRINT USING A$;D(I,J);
435 E=E+12:C=C+12
440 NEXT J:LPRINT
445 NEXT I
450 STOP
460 END
```

7

```
10  REM  PROGRAM FOR INVERSE OF THE TRIANGULAR MATRIX
15  REM  THE INVESE WILL SAVE IN  VINV
20  DIM A(30,30),B(30,30),BT(30,30)
30  INPUT "ORDER OF THE MATRIX";P
35  INPUT "LOWER TRIANGULAR MAT. FILE";V$
36  OPEN "I",#1,V$
40  FOR I=1 TO P : FOR J=1 TO P
50  IF J <= I THEN 70
60  A(I,J)=0 : GOTO 80
70  INPUT #1,A(I,J)
80  NEXT J: NEXT I
90  FOR I=1 TO P : FOR J=1 TO P
100 IF I >= J THEN 130
110 B(I,J)=0
120 GOTO 190
130 IF I=J THEN 185
140 B(I,J)=0 : FOR K=1 TO I-1
150 B(I,J)=B(I,J)+A(I,K)*B(K,J)
170 NEXT K
180 B(I,J)=-B(I,J)/A(I,I)
184 GOTO 190
185 B(I,J)=1/A(I,J)
190 NEXT J: NEXT I
200 FOR I=1 TO P : FOR J=1 TO P
210 BT(I,J)=B(J,I) : NEXT J : NEXT I
215 OPEN "O",#3,"VINV"
220 FOR I=1 TO P : FOR J=1 TO P
230 PRINT #3,BT(I,J) : NEXT J:NEXT I
235 CLOSE 3
240 STOP
250 END
```

ASSESSMENT OF GENETIC DIVERGENCE BY FACTOR ANALYSIS, IN GROUNDNUT (*Arachis hypogaea* L.)

By

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ABSTRACT OF A THESIS

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ABSTRACT

Factor analysis, Principal component analysis, discriminant analysis, and cluster analysis were carried out with a multivariate data on 30 characters of 62 bunch type groundnut varieties grown in upland during khariff 1982 and rice fallows during summer 1982. Vegetative, reproductive and growth factors were identified as the causative factors of genetic divergence in both the environments. A height factor was also found to work with rice fallows. The characters which were most amenable to change due to selection in these factors were identified. They were not found to agree with the results obtained from discriminant analysis. However, factor analysis was found more reliable than discriminant analysis. When facotr loadings were estimated from principal components, clustering of characters were found indentical to those obtained from factor analysis. Different patterns of factor loadings were obtained with genotypic and environment correlations. This showed the effect of selection on the genotypes. The genetic distance among the varieties were not same under both the environments, which may attributed to the presence of genotype-environment interaction. The varieties were plotted against two canonical axes, and the contigupus points were grouped into clusters. A heirarchical clustering with weighted average link method was performed and the results were presented as a dendrogram. Almost similar clusters of varieties were observed with the two procedures of clustering.