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SYMPOSIUM ON 'STATISTICAL TECHNIQUES IN PLANTATION CROPS'*

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The Chairman in his remarks observed that application of statistical tools is not available in all types of agricultural research. The uses of various statistical techniques vary from situation to situation. Experiments on plantation crops differ in many ways from those on seasonal crops It is important to study how the situations vary and how the statistical techniques are applied in plantation crops. Tea is one of the important plantation crop, particularly in Assam which produces major portion of Indian tea. Assam Agricultural University, Jorhat being the venue for the 42nd Annual conference of the Indian Society of Agricultural Statistics, the topic of one of the symposia was very appropriately selected as 'Statistical Technique in Plantation Crops'.

After the Chairman's observations, tne papers were presented followed by discussions.

It was felt that the present situation in respect of the Statistical methodology on perennial crops needs to be reviewed and assessed. It was also strongly felt that proper statistical techniques for planning experiments and analysis thereof needs to be discussed by the specialists in the field so that improvement in different areas. It was recommended that a symposium on "Statistical Techniques in Perennial Crops" might be organised in collaboration with Tea Research Association (Tocklai Experiment-

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al Station) and Assam Agricultural University. Organising such a symposium will go a long way in the improvement of perennial crops in the country.

Four paper were presented in the Symposia. The detailed summaries of these Papers are as follows :

1. STATISTICAL TECHNIQUES FOR EXPERIMENTATION WITH TEA IN NORTH EAST INDIA

AJIT K. BISWAS*, ASIM K. BISWAS* and P. K. KARMARK*

Statistical desings are used to make valid conclusions of field experiments. Development and refinement of statistical techniques for experimentation with perennial crop, like tea is important. Tea bushes are trimmed from early stage to build and maintain a flat top called, 'plucking table' at a low height. From two to three years, the plants produce pluckable shoots above the plucking table during March/April to December and are plucked at 7-9 days interval for manufacuring the black tea. The economic life span of tea plant is about 50 years. Statistically designed experiments on tea are being used at Tocklai experimental station since 1930's.

The specific problems of experiments on tea are :

(i) Plant mortality causing unbalanced data;
(ii) Data collected from the same plant over years being correlated create complexities in analysis and interpretation of data;
(iii) Changes of objective with time necessitate modification of treatments;
(iv) Residual effects of treatments may cause problems in laying out an experiment in the same site of an earlier experiment;
(v) In certain situations designs adopted for annual crops are not adequate for perennial crop like tea.

Out of several statistical methods developed for increasing efficiency/ minimising cost the following three techniques have been discussed.

(A) Analysis of covariance vis-a-vis experimental precision in tea;

(B) Number of plucking occasions necessary to provide an equally

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precise estimate of the treatment effects with those of the whole season's crop; and

(C) Statistical analysis techniques for long-term experiment data.

(A) Analysis of Covariance vis-a-vis Experimental Precision in Tea

(i) *Use of Pre-treatment Observations*

In North East India, pretreatment annual plot yields are recorded for :

(a) using the data as covariate in the analysis of covariance to adjust the post-treatment experimental data, and
(b) using the pre-treatment data for orientation of efficient block arrangement, considering pre treatment yield as soil fertility index.

To see whether a part instead of the pre-treatment whole season's crop will be sufficient, a study was made with 34 long-term experimental data. These experiments were conducted in RBD and factorial design.

From agronomic consideration pre-treatment annual crop was divided into early crop (upto June), Mid crop (July to August) and Late crop (September to December). It was found after covariance analysis that in some cases efficiency was almost same as the pretreatment whole season's crop.

(ii) *Method of Adjustment for Plant Mortality*

In long term experiments due to plant mortality the plot yield is to be adjusted by the number of plants/plot. Regression method and ratio type have been applied for adjustment and regression method gives higher efficiency.

(B) Number of Plucking Oceasions Required for Estimation of Treatment Effects

(i) *Division of Crop Period*

Tea shoots are plucked in 7 to 9 days interval from March/April to December giving thereby about 35 pluckings in a year. To examine if number of pluckings could be reduced for estate experiments a study was conducted with 20 long-term experimental data.

The whole season's crop was grouped into 21 distinct parts. The mon-

thly yields and/or yield of consecutive 2, 3, 4, 5, and 6 months combined together formed one part (x_1) and the difference of any of these part crops from the whole season's has been taken as the second part crop (x_2).

The results of the study suggest that crop from anyone of the two parts of the whole season's crop would enable the experimenter to make treatment comparisons almost as precise as the whole season's crop. This brings reduction of cost of recording and supervision and flexibility of conducting more number of experiments with the same number of supervisors by proper scheduling of the plucking operation in a season.

(ii) *Sampling Plucking Occasion*

Studies taking samples of plucking occasions from long-term trials using simple random, systematic and stratified sampling schemes show that a systematic sampling of 1 in 2 is uniformly better than simple random or stratified sampling of the same size and would provide estimates with a margin not exceeding 5% of the population mean with a chance of 1 in 20.

(C) Analysis of Long-term Experiments

Experiments on tea are conducted over several years in the same site and on the same tea bushes without changing the random allocation of the applied treatment from year to year. Plot yields are serially correlated depending on time lag. From 9 years data of an experiment, correlation between yield (y) and time lag (x) was found to decrease exponentially, the relationship being

$$Y = 0.652 - 0.281 \log X, \ (r = 0.74)$$

(a) *Autoregression with Time*

Treatment corrected plot yields as described by Papadakis and Bartlett have been obtained. For an experiment in RBD having t treatments in b blocks, the correction on the jth treatment ($j = 1, 2, \ldots, t$) can be represented by

$$Y_{ij} = y_{ij} - \bar{y}_{.j} + \bar{y}_{..}$$

where Y_{ij} is treatment corrected plot yield and y_{ij}, $\bar{y}_{.j}$, $\bar{y}_{..}$ are observed

plot yield, *j*th treatment mean and general mean respectively, These values obtained for a year are considered as concommitant for the corresponding plot of the following year. The method removes the major component of systematic effect over time.

(b) *Non-parametric Method*

Non-parametric test following Friedman and Shirley for multiple comparisons of treatments have been adopted. The tests improved the number of significant cases.

2. SCOPE OF FARM SURVEY METHODS IN PERENNIAL CROP INPUT RECOMENDATION : A CASE OF COFFEE

S. RADHAKRISHNAN* AND P. K. RAMAIAH*

Input recommendations for plantation crops on the basis of experiments as in the case of annual crops are not appropriate because in case of perennial crop, the same space is occupied by the plants over years. Surveys are expected to complement experiments and in short run they may even substitute the experiments. Feasibility of survey methods in plantation crops in general and coffee in particular is discussed.

In an agricultural experiment or survey, the factors that could be studied can be grouped into (1) variables observed, (2) factors held fixed and (3) variables unobserved.

The general method suggested to overcome the inherent variability such as maintenance of clonal stands, selection of uniform yielding plots etc. are impracticable in plantation crops. There are some specific problems and sources of variability for a particular plantation crop. The nature of control exercised over some of the factors itself, might pose major constraints of experimentation in perennial crops. As such collection need not be based on experiments alone.

The general criticism against use of survey methodologies in input recommendation is that the researcher could not exercise enough *ex* ante control over the factors studied and hence a cross sectional survey data may have all its variability inherent to the cropping system as well as the area studied. However, by exercising sufficient degree of *ex post* control, valid results could be obtained from surveys.

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Fertilizer response surface functions were fitted to field survey data of robust coffee in two agro climatic zones of Coorg district in Karnataka. The objectives were to estimate the regionwise yield response to age of bushes and fertilizer in small holdings of coffee plantation.

In the fitted model yield was dependent variable and fertilizer nutrient and age group were independent variables.

The analysis demonstrated the usefulness of survey results in providing information regarding region based input optima, general level of fertilizer response and the level of fertilizer use in a given set of agroclimatic and managerial conditions.

3. STATISTICAL APPROACHES TO COFFEE BREEDING

C. S. SRINIVASAN*

Coffee is a perennial plantation crop cultivated for its seeds from which the beverage coffee is prepared. Coffee breeding is mainly aimed at improving the yield and quality in addition to incorporating resistance to disease and pests. The achievements in coffee breeding have been made possible by the judicious application of cytological, genetical and statistical techniques.

Sample sizes required for measuring fruit and seed, leaf sizes and stem girth were determined as 4 to 12, 30 to 70 and 20 to 63 respectively.

Coefficients of variation for annual yield in coffee were found in the range of 30% to 60%

For vegetative characters such as stem girth, number of primary branches, number of nodes etc. the c.v. was generally in the range of 9% to 15%.

For reproductive characteries the c.v. was found to be ranging from 14% to 50%.

Significant positive correlation between stem girth and ripe cherry yield in coffee is reported by various workers. Correlation between other vegetative and reproductive characters, and correlation between seed thickness and cup quality have also been reported.

To evaluate the performance of coffee varieties Eberhart and Russel's (1966) stability model was applied. Heritability of yield was found to vary from 35% to 68% in different arabica coffee progenies. In robust coffee the heritability for yield was higher ranging from 69% to 92%.

Application of statistical techniques in studying heterosis, Index selec-

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tion, Genetic distance and goodness of fit also has been reported. In coffee breeding to identify superior parents, hybrids and selections for the improvement of yield, quality and resistance to disease, application of statistical technique is useful.

4. STATISTICAL DESIGNS AND ANALYSIS OF EXPERIMENTS IN AGRO FORESTRY

P. N. BHARGAVA*, B. L. CHOUDHARY* AND P. N. SONI*

It is a common assumption among the farmers that nothing comes under the canopy of a tree. It is rather difficult to predict that all the trees and agricultural crops have a greater compatibility and interacting each other kindly. There are a number of factors interacting for the above combination. One of the important factors is the spacing between trees and the seasonal crop grown under the canopy of the tree. The number of rows of arable crops on which the delitarious effect of the tree exists, the orientation of planting of tree rows etc. are also required to be examined through experimentation. The other important factor which also has a greater effect on the interaction of perennial trees and arables is the tree-crop interface which expresses the relative competitiveness between the plant mixtures at a particular space or boundry for the better establishment. The tree crop interface studies are of equally immense value in agro-forestry system particularly with reference to its management.

In the present paper, the lay-outs generally adopted to study the above aspects are presented. One approach to the analysis of data consists of forming an index of combined yield for each plot and then analyse the variate of indices by analysis of variance technique. Pearce and Gilliver (1978) have opined that the two components in intercropping system are correlated and hence, the covariance between the yields of two-subsystems should be taken into consideration. Thus, they suggested bi-variate analysis for such type of data. Lastly, Bhargava and Choudhary (1988) suggested the distribution free approach for the analysis of this type of data. The details of these three methods will also be discussed in the present paper.

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