

## LIST OF PUBLICATIONS

### (a) Papers Published

1. BAJPAI, PK and PRABHAKARAN, VT (2000). A new procedure for simultaneous selection for high yielding and stable crop genotypes. *Ind. J. Genet.*, 60(2), 141-152.
2. BATRA PK,;PARSAD, RAJENDER, GUPTA, VK and KHANDURI, OP (1999). An alternate strategy for design and analysis of experiments involving split application of fertilizer. *Statistics and Applications*, 1(2), 175 – 187
3. BHATIA, AK and KAUR, RAJINDER (1998). Statistical assessment of rice based Cropping Sequences. *Journal of Farming Systems Research and Development*, Vol. 3 & 4, 36-41.
4. BHATIA, DK; ARYA, SN; GUPTA, HC and MATHUR, DC (2001). Small area estimation of buffalo milk production. *Haryana Economic Journal, Karnal, Vol XXI (1-2), pp 110-113*
5. DAS, SONALI and MINI, KG (1999). Artificial neural networks for prediction in agriculture. Proceedings of 5th International Conference on Cognitive systems. "Cognitive Systems Reviews and Previews", *Phoenix Publishing House, New Delhi, 278-285.*
6. DEY, DEBJANI and DAS, SONALI (2000). Management of the National Pusa Insect Collection Information Using RDBMS with Special Emphasis on Order . *Hymenoptera. Shashpa*. 8(1), 23 – 28.
7. GUPTA, AS; SAXENA, BC and SOOD, RM (2000). Impact of command area on productivity. *Agricultural Situation in India, LVI(10):615-617.*
8. GUPTA, HC; SINGH, JAGBIR and KATHURIA, OP (2000). Methodological investigation on Post Harvest Losses. *Journal of the Indian Society of Agricultural Statistics, 53(2): 161-171.*
9. KAUR, RAJINDER and BHATIA, AK (1998). Crop residue management in rice based cropping systems. *Journal of Farming Systems Research and Development, Vol. 3 & 4 (1&2), 32-35*
10. KHATRI, RS and GOYAL, JP (1999). Estimation of wool production- some problems and prospects, *Journal of Indian Small Ruminant, 5(2): 78-81.*
11. KHURANA , GL; KUMAR, RAJENDRA and GARG, RN(1998 ) Analysis of Means method for exploiting interactions of Agronomic Factors at Reduced levels . *New Botanist, Vol XXV :11 – 19.*
12. KHURANA , GL; KUMAR, RAJENDRA and GARG, RN ((1998 ) Interactions of Environment Vs. Package of Agronomic Factors in Jowar – wheat sequence and their testing procedures. *New Botanist Vol XXV) : 21-28.*
13. KUMAR, RAJENDRA; SREENATH PR and JAIN, SP (2001) . Effect of coefficient of variation on the heterogeneity of error variance in Agricultural Field Experiment. *Journal of Annals of Agricultural Research. Vol 22(1) .*
14. KUMAR, RAJENDRA and KAPOOR, JK (2001). Study of response surface for cultural cum manurial agricultural field experiments *Journal of Annals of Agricultural Research, Vol 22 (2)*
15. LAL, KRISHAN; GUPTA, VK and BHAR, LAL MOHAN (2001). Robustness of designs against missing data. *Journal of Applied Statistics, 28(1), 63 – 79*
16. MEHTA, SC, AGRAWAL, RANJANA and SINGH, VPN (2000). Strategies for composite forecast. *Journal of the Indian Society of Agricultural Statistics , New Delhi, Vol. No. 53, No. 3.*
17. NARAIN, P.; SHARMA, S.D., RAI, S.C. and BHATIA, V.K. (2000). Regional disparities in socio-economic developments in Tamil Nadu. *Journal of the Indian Society of Agricultural Statistics, 53(1), 35-46.*
18. PARSAD, RAJENDER; SREENATH, PR and AGARWAL, NITI (1999). Construction of balanced bipartite block designs with nested rows and columns. *Calcutta Statistical Association Bulletin, 49(195-196), 177 – 185.*
19. PAUL, AMRIT KUMAR and BHATIA, VK (2000). Empirical comparison of different methods of estimation of heritability of stayability in dairy cattle. *Journal of the Indian Society of Agricultural Statistics, 53(2), 196-206.*
20. PAUL, AMRIT KUMAR and BHATIA, VK (2000). Heritability of stayability by path coefficient approach when herd life is influenced by unrelated auxiliary characters. *Sankhya, Series B, 62(3), 463-471.*

21. PRAJNESHU and DAS, PK (2000). Growth models for describing statewide wheat productivity. *Journal of the Indian Society of Agricultural Statistics*, 34, 179-81.
22. RAI ANIL, MISHRA PRACHI and SINGH RANDHIR (2000) GIS based spatial sampling techniques in agricultural surveys. *Proceeding of an International Conference on Recent Developments in Statistics and Probability and their Applications. Dec;30 2000 to Jan 2, 2001*, 381 - 384.
23. RAI, ANIL, RAI, T, LAL, MOHAN AND GARG, R.N, (1998). An evaluation of the performance of high yielding varieties of rice in Haryana state. *JNKVV Res J:32(1&2) 8-11*.
24. RAI, ANIL, SINGH, M and PATHAK G.M.(2000). A study of Agroforestry in Chhachhroli block of Yamuna nagar district of Haryana *Journal Annals of Agricultural Research 21(1): 17-22*.
25. RAI, ANIL, SRIVASTAVA, AK and GUPTA, HC (2001) Small sample comparison of Modified Chi-square test statistics for survey data. *Biom. J.*, 43 (2), 47-59.
26. RAIGER, HL AND PRABHAKARAN, VT (2000). A statistical comparison between non-parametric and parametric stability measures. *Ind.J.Genet.*, 60(4), 417-432.
27. RANA, PS and SINGH, I. (2000). Premium rates estimation using nonparametric density approach in crop insurance in India. *Afro-Asian J.Rural Development.*, 33(2), 91-102.
28. RAO, AR and PRABHAKARAN, VT (2000). On some useful interrelationships among common stability parameters. *Ind.J.Genet.*, 60(1), 25-36.
29. RUSTOGI, RL AND AGARWAL, SC (2000). Cost of rearing and maintenance of goat in rural areas of Mathura district (U.P.), *Jr. of Animal Research*, 34(1): 18-23
30. SAKSENA, ASHA, KAUR, AJIT and SIKARWAR, HS (2001). A study of behaviour of wheat response to long-term fertilizer application” *Annals of Agri. Res. , Vol. 22(1), March 2001*.
31. SAKSENA, ASHA; BHATIA, AJIT KAUR and SIKARWAR HARNAM SINGH (2001). Study of behaviour of wheat response to long term fertilizer application. *Annals of Agricultural Research. MS 2622; Vol. 22(1)*
32. SARADA, C. and PRAJNESHU (2000). Lagrangian-Poisson distribution for describing spatial spread of aphids. *J.Aphidol.*, 14, 33-40.
33. SAXENA, BC; TYAGI, KK and BINDAL, VIJAY. (2000). Techniques for determination of intake by bovines through grazing. *Indian Journal of Animal Science*, 70(11): 1105-1107.
34. SHARMA, BS, PRABHAKARAN, VT and PIRCHNER, F. (2000). Gene action and heterosis in lifetime traits. *J.Ani.Breed.Genet.*, 117, 319-330.
35. SHARMA, YK.; SINGH, RANDHIR; RAI ANIL and VERMA, SS (2000) Regression estimates from survey data for small sample sizes. *Journal of the Indian Society of Agricultural Statistics.* 53(2), 115-124.
36. SINGH, RANDHIR; RAI, ANIL and CHHIKARA, RS (2000). Use of Remote Sensing satellite data for crop yield estimation. *Proceeding of an International Conference on Recent Developments in Statistics and Probability and their applications, Dec 30, 2000 to Jan 2, 2001*, 448 - 451.
37. SINGH, RANDHIR and SHARMA, YK (2000): Regression estimators from survey data for small sample sizes. *Journal of the Indian Society of Agricultural Statistics*, pp 115-124.
38. SRIVASTAVA, R.; PARSAD, RAJENDER and GUPTA, VK(2000). Structure Resistant Factorial Designs. *Sankhya B*, 62 (2), 257-265.
39. SUD, UC and SRIVASTAVA, AK (2000). Estimation of population mean in repeat surveys in the presence of measurement errors. *Journal of the Indian Society of Agricultural Statistics*, 53(2).
40. VARGHESE CINI; VIJAYA B and SHARMA, VK (2000). Crossover designs for comparison of two treatments in presence of residual effects. *Indian J. Anim. Sci.* 70(8), 862-65.
41. VARGHESE, CINI, and SHARMA, VK (2000). On totally balanced change-over designs. *Journal of the Indian Society of Agricultural Statistics*, 53(2), 141-150.
42. VENUGOPALAN, R. and PRAJNESHU (2000). Pella-Tomlinson nonlinear statistical model with autocorrelated errors. *Journal of the Indian Society of Agricultural Statistics*, 53, 12-19.

#### Research papers accepted for publication

1. GUPTA, AS; and SAXENA, BC. Vital demographic parameters in sheep and goats. *Indian Veterinary Journal*.
2. GUPTA, VK ; RAMMANA, DVV and PARSAD, RAJENDER. Weighted A-optimal block designs for comparing test treatments with controls with unequal precision. *Journal of*

*Statistical Planning and Inference* . (Special issue in the memory of Professor YAMAMOTO)

3. KAUR, RAJINDER and BHATIA, AK. Performance of oilseed crops in comparison to other crops in different crop sequences. *Brassica News*.
4. KHURANA, GL ; KUMAR, RAJENDRA and GARG, RN. Identification of agronomic factors for higher grain productivity . *New Botanist, Vol. XXVI*.
5. KHURANA, GL; KUMAR, RAJENDRA and GARG, RN. Testing of Adaptability of complex designs in C.S.R. experiments. *New Botanist Vol. XXVI*.
6. KUMAR, MUKESH ; SINGH, P.V. and KUMAR, ANIL Flowering and bulb production of Tuberose (Polianthes Tuberosa) . *Journal of Farming systems Research and Development*
7. KUMAR, MUKESH ; SINGH, P.V. and KUMAR, ANIL. Effect of spacing, levels of nitrogen and GA III on growth and yield of Tubedrose (Polianthes Tuberosa) . *Journal of Farming Systems Research and Development* . 6(1 & 2)
8. PARSAD, RAJENDER and GUPTA, VK. Balanced Bipartite Row – column Designs Ass. combinatorial .
9. PRAJNESHU AND RAVICHANDRAN, S. (2001)- Use of expected-value parameters for estimating length-weight relationship in fishes. *To appear in Ind.J.Fish.*, 48.
10. RAO, AR and PRABHAKARAN, VT (2001). A bootstrap method of estimating heritability from varietal trial data. *To appear in Ind. J. Genet.*, 61(2).
11. RAVICHANDRAN, S. and PRAJNESHU (2001). Dynamical time-series modelling for describing fish production. *To appear in Ind.J.Ani.Sci.*, 71
12. RAVICHANDRAN, S. and PRAJNESHU (2001) - State space modelling versus ARIMA time-series modelling. To appear in *Journal of the Indian Society of Agricultural Statistics*
13. SARKER, S. and RANA, P.S. (2001). On mathematical formulation of lactation curves. *To appear in Ind.J. Ani.Sci*.
14. SINGH, JAGBIR and BATHLA, HVL. Estimation of food grain losses and seasonal fluctuation. *Agricultural Situation in India*.
15. SINGH, R, SEMWAL, DP, RAI, A. and CHHIKARA, RS (2000) Small area estimation of crop yield using remote sensing satellite data, *Int. J. Remote Sensing*. (Accepted).
16. SINGH, RANDHIR. Small area estimation of crop yield using remote sensing satellite data. *International Journal of Remote Sensing*.
17. SRIVASTAVA, AK and JHA, GK. Some Methodological Issues in Agricultural Surveys. *Jr. of Income & Wealth*.
18. SUD, UC; SRIVASTAVA AK and SHARMA, DP. On a biased estimation in repeat surveys. *Journal of the Indian Society of Agricultural Statistics*
19. VARGHESE, CINI and GEORGE, KC. A composite sow index and its effects due to rice, parity and season. *Indian Journal Animal Science*.
20. VATS, MR ; SEHGAL, DK and MEHTA, DK. Extraneous factors affecting cumulative yields in long-term fertilizer experiments. *Indian Journal of Agricultural Research*.
21. VARGHESE, CINI; RAO, AR AND SHARMA, VK. Robustness of Williams square change-over designs. *Metrika*.

## Research Project Reports

### Published

1. A methodological investigation in estimating seasonal fluctuations in post-harvest food grains losses (wheat) by *Jagbir Singh, HC Gupta and OP Kathuria*
2. A pilot study of Agroforestry in Chhachhauili block of Yamunanagar district (Haryana) (2000) by *VPN Singh, Anil Rai and VK Jain*
3. A Study of variance estimation in complex surveys (2000) by *Anil Rai, AK Srivastava and Man Singh*
4. Agricultural Research Data Book 2001 by *HVL Bathla, KK Tyagi, RS Khatri, Jagbir singh, RM Sood, JP Goyal, SC Agarwal, MS Verma and BN Chakraborty*
5. CD-ROM /Electronic Book on design and Analysis of Agricultural Experiments (2000) by *Rajender Parsad,, R Srivastava and VK Gupta*

6. Estimation of Demand for Credit and its impact on employment and income by *UN Dixit, Ashok Kumar and Ant Ram, .*
7. Estimation of regression coefficients from sample survey data (2000) by *UC Sud, Anila Rai, IC Sethi and VPN Singh*
8. Evaluation of Fatigue Score card for Animal, Annual Report of AICRP on Increased utilization of Animal Energy with Enhanced System Efficient in Collaboration with KVK, Reweri by *M. Din, Jyotsna, P.K. Srivastava and Rajender Parsad*
9. Monograph on design of experiments (1990-2000) by *VK Gupta, Rajender Parsad and Seema Jaggi*
10. Planning designing and analysis of experiments planned on stations under the Project Directorate for Cropping Systems Research Status Report (1999-2000). by *Rajinder Kaur, Ajit Kaur*
11. Statistical modelling for projection of bovine populations and prediction of milk availability by *SN Arya and SC Aggarwal*
12. Studies on optimality of block design for making test treatments – comparisons (2000) by *Rajender Parssad R. Srivastava V.K. Gupta*
13. Study for estimation of area and production of important vegetable crops on the basis of partial harvest by *AK Srivastava, DL Ahuja, DC Mathur and K Chugh*
14. To study the effect of various input components on the yield of important vegetable crops by *AK Gupta*
15. Use of discriminant function of weather parameters for developing forecast model on rice crop(2000) by *T. Rai and Chandrahas*
16. Use of remote sensing satellite data in crop surveys by *Randhir Singh and RC Goyal*

### ***Finalised***

1. Development of early warning and yield assessment models for rainfed crops based on agrometeorological indices by *Asha Saksena, R.C. Jain (Retired on 30.11.99), R.L. Yadav*
2. Pilot study for developing Bayesian probability forecast model based on farmers' appraisal data on wheat crop by *Chandrahas and T. Rai*
3. Fertilizer response ratios for different crops in India by *SDSharma, PK Batra, VK Sharma and NK Sharma*

## **DISSERTATIONS APPROVED**

### **Ph.D. (Agricultural Statistics)**

1. **DILEEP KUMAR PANDA - On Robustness of Diallel and Trialallel Crossing Plans Against Exchange or Interchange of Crosses**

In plant and animal improvement experimentations, various forms of mating design like diallel, trialallel and double cross play a vital role in evaluating the action or interaction of genetic materials. All these mating designs are to be embedded in an experimental design called environmental design to obtain observations for further analysis using appropriate statistical procedures for drawing valid conclusions. Sometimes, a scientifically planned experiment turns out to be useless when some disturbances occur and violate the assumptions required by the statistical procedures. Thus, it is of interest to investigate the designs that are insensitive to such aberrations. An attempt has been made in this thesis to study the robustness of block designs for



diallel and triallel crossing plans against exchange or interchange of crosses using connectedness and efficiency criteria. It has been shown that all binary balanced block (BBB) designs for complete diallel crosses are robust against exchange of a cross in one of the blocks except a BBB design with  $p$  (number of lines) = 4,  $b$  (number of blocks) = 3 and  $k$  (block size) = 2. The balanced block designs for diallel crosses in which each of the line appears same number of times in each of the blocks have also shown to be robust. The above class of designs are also robust against interchange of a pair of crosses.

Robustness of optimal triallel crossing plans against exchange or interchange of crosses has been studied. It has been observed that all designs for  $p \geq 10$  are robust according to connectedness as well as efficiency criteria.

(Guide: Dr. V. K. Sharma)

## 2. HANUMAN LAL RAIGER - On Stability Concepts, Stability Assessments and Improved Procedures for Varietal Selection.

One of the important steps in any crop improvement programme is to assess the performance of improved varieties in multi-environment trial for identifying superior varieties for large scale propagation. In actual practice varieties perform differently in different environments, leading to alteration of their ranking in the environments. The non-parametric techniques of ranking has been used to study the genotypic- environment interaction by a galaxy of workers. However, there has been hardly any attempt to tackle the difficulties that arise when non-linear interactions are present. A procedure for dealing such situation is developed under the present study. Further, different computations on Type – I error and power of the test are made for evaluating the merits of various stability measures. Performance of non-parametric measures vis-à-vis parametric measures has been assessed based on the above criteria. Application of stability measure(s) to real data on pearl millet was also made in regard to their suitability for stability assessment.

(Guide: Dr. V. T. Prabhakaran)

## 3. SARADA CHUNDURI - Statistical Study of Spatial and Temporal Aspects of Pests Populations and Pesticide Consumption

During the last three decades or so, major advances have been made in increasing crop productivity as a result of large scale adoption of modern high yielding varieties and improved technologies. This all-round intensification has resulted in increased pesticide application in agriculture, which in turn, accentuated the pest problem. It was estimated that over one lakh species of pests annually destroy food sufficient to feed 135 million people all over the world. In India, pests destroy crop worth several thousands of every year. Thus, to tackle this problem, proper plant protection measures are of great relevance. Unfortunately, large scale and unscrupulous application of pesticides in intensive agriculture has resulted in large number of adverse effects such as human and animal health hazards, degradation of natural resource, environmental pollution and total imbalance of agro - ecology. However, a total ban on pesticides without availability of economically viable alternatives would result in significant reduction in current production and would also raise food prices several times. Therefore, proper management of pest population and sustainable pesticide use is necessary for preventing yield losses to ensure food supply to teeming millions and preventing adverse effects of use of pesticides. To this end a study of spatial and temporal aspects of pest population growth as well as statistical modelling of pesticide consumption has been carried out. Four important Generalized (stopped - sum) distributions, viz. Neyman Type - A, Thomas, Polya - Aeppli and Lagrangian - Poisson distributions are studied to understand spatial spread of pest populations. Two methods of parameter estimation, viz. 'Method of moments' and 'Method of maximum likelihood' are discussed. Unfortunately most of the standard statistical software packages, like statistical package for social sciences (SPSS) and Statistical Analysis System (SAS) do not contain computer programs for fitting these distributions/. Therefore, these are developed for fitting the above mentioned contagious distributions. As an illustration, these distributions are fitted to the data sets collected from entomological literature. The two nonlinear curvature measures, viz. Intrinsic nonlinearity and parameter effects nonlinearity are described in detail along with their

computations. As these measures are expressible as ratio of two matrices, containing first and second partial derivatives, their evaluation involve huge computations. The procedure for achieving the task is thoroughly discussed. As an illustration, curvature measures are computed for a nonlinear dynamical model for aphid population growth applied to some data on potato aphid. Marginal curvatures and profile -  $t$  plots for individual parameters are studied. This type of investigation helps in knowing to which parameter is showing highly nonlinear behaviour and hence, needs a reparameterization. Further, a procedure for choice of suitable reparameterization is described. The technique of 'Expected value parameters' as well as 'Simulation studies' are used to identify suitable reparameterization and illustrated with an example. The sensitivity analysis is carried out by first varying single parameter and thereafter by simultaneous variation of two parameters. The corresponding two and three - dimensional graphs are presented. Further, the choice of design points for a nonlinear model for better estimation with the help of sensitivity functions is also discussed.

'Statistical Modelling' of pesticide consumption data of the country during the period 1966-67 to 1997-98 was carried out Polynomial functions approach and time - series modelling are considered for modelling purposes. In the former, a second degree polynomial function with AR(1) error structure is found to be appropriate for the data under consideration. In the latter approach, two procedures viz ARIMA models and piece-wise threshold time - series models are employed for describing the pesticide consumption data. Among several models considered, ARIMA (1,2,1) is found to be appropriate model based on autocorrelations and partial autocorrelation functions. A noteworthy, feature is that pesticide consumption increased upto year 1990 and is exhibiting a downward trend thereafter. To capture this, a piece-wise threshold time - series model is considered by taking 1990 as the threshold year. Two ARIMA submodels, one for the period up to 1990 and the other for the period beyond 1990 are fitted. The performance of this model is found to be the best. However, there is no guarantee that this good performance of the selected models continue to hold in future also. The moment pesticide consumption starts showing an increasing trend, which is most likely to occur sooner than later, the models need to be fitted again to the updated data to arrive at the most appropriate model.

(Guide: Dr.Prajneshu)

#### 4. S. RAVICHANDRAN - A Study of Dynamical Modelling in Agriculture

In the field of agriculture, data are usually collected over time. So, dynamical techniques are of great relevance for modelling and forecasting of such data sets. Introduction deals with various categories of mathematical models are discussed. Some important nonlinear growth models and surplus production models are also described along with estimation procedures for fitting such nonlinear models. A brief review of ARIMA time series modelling approach is also provided. Use of "expected-value parameters" for fitting nonlinear statistical models is also discussed. This type of reparameterization results in a model having close-to-linear behaviour and low correlations among parameter estimates. The well-known nonlinear allometric model and Fox surplus production model are considered. The explicit expressions in terms of expected-value parameters are derived and the methodology is demonstrated by applying it to real-life fisheries data. Time-varying state space regression modelling approach using Kalman filtering technique is also discussed. As an illustration, the methodology is applied to all - India data on marine fisheries. Studies on another promising approach, viz. State space modelling approach using Kalman filtering technique is discussed. The advantage of this technique is that it can take into account the time dependency of the underlying parameters. As an illustration, modelling and forecasting of all-India marine products export data is carried out. "Structural time series modelling (STM)" approach when there is presence of prominent trend is discussed. Specifically, three types of STM models, viz. Local level model (LLM), Local linear trend model (LLTM), and Local linear trend model with intervention (LLTMI) are discussed along with their estimation procedures and then applied these to data sets from agriculture. Structural time series modelling for describing all-India milk production based on logistic growth curve is also discussed. All - India shrimp export data is also modelled via STM when the series under consideration follows an autoregressive process. It is found that STM performs much better than ARIMA approach, as judged by various goodness of fit criteria. Finally, identified model is used to forecast shrimp export for the next five years. Various types of structural time series models, which are capable of explaining "cyclical fluctuations" is discussed. As an illustration, all-India lac production data, which has prominent five years' cycles along with a declining trend is modelled. Results are

compared with corresponding analogue from ARIMA family. Finally, forecasting of all-India lac production data is carried out. For modelling seasonal fluctuations in fish populations, appropriate models from the family of STM are identified. A heaspect of this approach is that the peculiar features, like trend, and seasonal fluctuations, exhibited by the data dictate the particular model from the family of STM to be employed. Two types of forms, viz. dummy seasonality, and trigonometric seasonality are considered for describing seasonal fluctuations. As illustrations, these models are fitted to quarterly landings of silverbellies and croakers in Tamil Nadu, India during the period 1975-96. Comparisons with ARIMA models reveal that the former approach is much superior to the latter. Finally, the identified models are used for forecasting purpose. Two new promising approaches, viz. “Bayesian analysis of time series (BATS) ” and “Structural time series modelling (STM)” are discussed and applied to model India’s foodgrain production data for the period 1966-1999 is discussed. Forecasts for the year 2020, on the basis of these two models, are made. Bayesian nonlinear, nonnormal state space (BNS) formulation for this model is also discussed in this chapter. Posterior density function is obtained by using Gibbs sampling procedure. The relevant computer program for fitting of BNS model is also appended. As an illustration, the methodology is applied to some fisheries data employing “Bayesian inference using Gibbs sampling (BUGS)” software package.

(Guide : Dr. Prajneshu)

## **M.Sc. (AGRICULTURAL STATISTICS)**

### **1. AMITAVA DEY - Robust Block Designs for Diallel Crosses Against A Missing Observation**

Diallel crossing is a useful method for conducting plant-breeding experiments. The diallel cross is a type of mating design used to study the genetic properties of a set of inbred lines.

Non-availability of data in a planned experiment may sometimes lead to such a poor residual design that it may not even be possible to estimate all the elementary treatment contrasts through the residual design, or it may happen that the residual design is treatment connected but the efficiency of the residual design may fall considerably as compared to the original design. Thus it is necessary to study the robustness of block designs for diallel crosses against missing observations. Robustness of block designs for diallel cross experiments have been investigated for the situation when the interest of the experimenter is in estimating the general combining ability effects assuming that the specific combining ability affects are excluded from the model. The block designs for diallel cross experiments that are robust have been identified against a missing observation, using connected and efficiency criterion. Catalogues have been prepared of robust matting designs as per efficiency criterion of robustness. Robustness of binary balanced block designs for diallel cross experiments generated from NBIB designs against one complete block missing have also been studied.

(Guide:Dr.R.Srivastava)

### **2. JUGNU ANSARI - An Investigation on the Effect of Mating Designs on the Variance of Heritability Estimates**

For planning the breeding programmes for animal and plant improvement the method of selection is an important aspect. The reliability of this method is based on the magnitude of genetic differences among the individual of base population to which this method is applied. A quantitative measure of genetic variability associated with this description is provided by the coefficient of heritability. The value of heritability coefficient should lie between zero and one. But, while dealing with animal breeding data, frequently the sample estimates of heritability coefficient turn out to be either negative or a value greater than unity. In the present dissertation a critical and comprehensive review of past work done on the occurrence of inadmissible estimates, their causes, optimum designs for experimentation and procedures for improved estimation of heritability has been done. The estimation of heritability and its variances by bootstrap technique was also studied to gain insight into the existing gaps. A detailed description of simulation and bootstrap techniques has been used in the present work. For this study , generation of random numbers, normal variates with certain parametric values and simulating master samples from half –sib and full-sib models, that are used for bootstrapping in order to get variance estimates of

heritability . It also gives the optimum sample sizes, structure and number of bootstrap replications for obtaining meaningful estimates of heritability. We compared variance of bootstrap estimates of heritability obtained from half-sib method with those determined from sire component of full sib analysis. A second comparison was carried out between sire and sire+dam components of full-sib analysis. Here also these comparisons are based on the bootstrap estimate of variances.

(Guide:Dr.V.T.Prabhakaran)

### 3. NAVEEN CHONA - Estimation of Fish Catch from Inland Resources at Small Area Level

The growing demand for reliable estimates at smaller areas makes small area estimation in survey sampling an important subject. The sample surveys planned for estimation for larger areas, if used for small areas then sample sizes are inadequate. In case of inland fisheries in India, the position of statistics of catch from different inland resources is not satisfactory. The concept of small area has not so far been explored in this area and it was considered necessary to investigate some small area estimation techniques in case of inland fisheries. For estimating the fish catch of different species (Small Areas) at district level, three estimators namely direct, raking ratio and composite estimators have been developed. Total numbers of water units in selected districts have been considered as the auxiliary variable in developing these estimators. It has been observed that for estimate of fish catch of different species in these districts, the composite estimator has proved to be the best with minimum percent standard errors as compared to other estimators i.e. direct and raking ratio.

(Guide:Dr.H.V.L Bathla)

### 4. N.OKENDRO SINGH - Study on the Effect of Sample Size and Structure on the Bootstrap Estimates of Variance of Heritability

The present investigation was conducted to study the effect of sample size and structure for estimating the precision under different mating designs of heritability and to decide the optimum number of bootstrap replications required for precision of heritability. This was achieved empirically by using the simulated data for different values of population parameters. The bootstrap technique which is an analytical and highly computer oriented method was used to obtain the estimate of heritability, bias and standard error. The heritability estimates were obtained by two different procedures namely regression of offspring on parent and half-sib analysis. In the first case, the results were obtained from the data simulated by parent-offspring model by selecting different master samples of 200, 500, 1000 and 1500 pairs of observations from the populations with different heritability levels for different bootstrap replication numbers. The optimum number of bootstrap replications required to obtain stable estimate of standard error of heritability for all the three cases considered was about 100 that required 100 above for small sample. The optimum sample size required to get precise estimate of standard error for both low and moderate heritability values was about 1000 but the sample size of 500 was sufficient for high heritability value. The bootstrap estimates of heritability using half-sib analysis was obtained by drawing samples of 200, 500 and 800 for different family structures of each sample size. As in other method the stable estimate of bootstrap standard error required was about 200 bootstrap replications in all the levels of heritability values taken. It was found that the optimum family size and structure was 10 sires and 50 progenies per sire for low heritability. Similarly, the optimum sample size and structure for getting the precise estimate of standard error of heritability were 40 sires and 10 progenies per sire and 20 sires and 10 progenies per sire of moderate and high heritability values respectively.

(Guide: Sh.S.D.Wahi)

### 5. RAMESH KOLLURU - On Some Aspects of Growth Patterns of Crossbred Cattle

The research on cattle growth is one of the important studies in the animal sciences. Although methods are available in literature for the analysis of growth data, no universal method is recommended. In the present study data on body weight was taken from birth to an age upto 27 months on 25 crossbred cattle. As the scatterplots revealed a sigmoid shape and also that the growth of animals, in general follow a non-linear distribution, five non-linear models were used to



model weight age data for the animals. Also that these sigmoid models are empirical in the sense that the parameters have some biological interpretability. Comparisons were made among these models for goodness of fit. The three sigmoid models viz., Brody, Von-Bertalanffy and Gompertz over estimated the weights. Richards and Logistic models suited the data pattern. Logistic model in comparison with Richard's model, is computationally easier to fit. In the above said models parameters were estimated using ordinary least squares technique. But the assumptions for applications of this technique are rarely met in practical situations. So we estimated the parameters under heteroscedastic variance structure. The estimates obtained so revealed to be better. Since the data is taken on repeated measurements the errors may be of two types, systematic and random. The parameters were estimated through Hierarchical non-linear modeling. Using the hierarchical non-linear models, the data patterns are better described compared with the earlier techniques.

(Guide: Dr.P.S.Rana)

#### 6. SUMANTA KUMAR DAS - Optimization Techniques under Multiple Frame Sampling for Multivariate Stratification

The approach of multiple frames includes independent selection of samples from different frames and to obtain combined estimate on the basis of both the samples and optimization of the sample sizes and the weights attached to the sample portion coming from the common frames. Optimization in sampling is normally viewed in terms of variance and cost function. Here we choose a function of several variables, which is maximized or minimized subject to one or more constraints. The constraints are generally equalities or inequalities, which must be satisfied by the variables of the objective function. Optimization is an important aspect in the study of sampling from multiple frame situations. A sampling design is considered for multipurpose surveys in which several stratifying variables are available and the objective is to estimate the totals or means of several variables each highly correlated with one of the stratifying variable. The design involves selecting separate subsamples independently by stratifying variable in turn. Estimation then involves pooling data from separate subsamples using multiple frame sampling. The strategy is compared with standard approaches such as ratio regression in simulation study and relative efficiency will be determined.

(Guide:Dr.B.C.Saxena)

### M.Sc.( COMPUTER APPLICATION)

#### 1. BASANT KUMAR - Pest Management Information System on Sugarcane

In spite of India ranking first in area and production among the sugarcane growing countries of the world, yield per hectare is still much lower than most of the countries. Among the various reasons of low productivity, attack insect/pests, diseases, weeds, mites etc plays an important role. It is estimated that about 10% of the total sugarcane crop in the country is destroyed every year as a result of the attack of several pests, disease and infestation by the weeds. Solution are available in the form of control measures and IPM (a sustainable approach to manage the insect/pests problems by combining biological cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks). But the information, which is available in the form of books, journals, magazines etc. are beyond the reach of common person, also they are not in updated form. So a need was felt to put the information in electronic format through the Internet. Pest Management Information System in Sugarcane (PMISS) can be implemented as a network-based system with a server. It maintains information regarding Sugarcane and its IPM primarily with emphasis on insects, diseases, weeds and mites infesting it. There is also provision to insert, update and delete the information. It has three-layered architecture. It has been developed in HTML, JavaScript, Microsoft Access and Java Servlets & JDBC. PMISS runs at any node of Internet through a browser.

(Guide: Dr.P.K.Malhotra)

## 2. MD. ZUBIR AHMAD - Information System for Apple Crop

Apple fruit is one of the important fruit of India. Apple industry is the backbone of Indian fruit industry and APEEDA has identified apple as one of the eight fruits for accelerating export potential. Though apple is grown in different states but major share is contributed by only 3 states. Information on Apple crop is available in the form of books, journals and popular magazines etc. and are beyond the reach of needy across the world. Extension agency also requires updated information to advise the farmers on apple cultivation. The present investigation was carried out with the idea of developing an Information System for Apple Crop (ISAC) that will provide information on all aspects of apple cultivation, processing and marketing. The system has been developed using Visual Basic at the front end and MS-Access at the backend. ISAC runs at any windows based computer system. This software also has help and index to facilitate smooth operation. A person with little computer knowledge can operate and get desired information.

(Guide: Sh.Mahesh Kumar)

## 3. PRAKHAR PRASHANT - Integrated Pest Management Information System on Tomato

India has a major share in the agriculture production in the world and the second largest producer of fruits and vegetables. With the advent of new upcoming technologies and research work undertaken in the field of agriculture, it has become possible to minimize the losses in crop production due to infestation by the insects/pests, diseases, weeds and mites. India has taken strong initiative in the fruits and vegetables research to increase production and productivity in a sustainable manner. Information on tomato crop is available in the form of books, journals, magazines etc. are beyond the reach of common person across the world. So there is a need to put the information in electronic format through the Internet. The present investigation was carried out with the idea of developing Integrated Pest Management Information System on Tomato (IPMIST) software that incorporates basic information on Tomato, its IPM and infestation by various insects, diseases, weed and mites and can be accessed through Internet. It has a three-layered architecture. It has been developed in HTML, JavaScript, Microsoft Access and Java Servlets & JDBC (the latest technology of Sun Microsystems). IPMIST can be implemented as a network-based system with a server. There is provision to insert, update and delete the information.

(Guide: Dr.P.K.Malhotra)

## 4. RACHANA CHADHA - Digital Image Processing of Indian Remote Sensing Satellite Data

Remote Sensing is a multidisciplinary activity which deals with the Inventory, monitoring and assessment of natural resources through the analysis of data obtained by observations from a remote platform. The digital images obtained need to be manipulated and interpreted with the aid of computer. Therefore, software is required to process the digital image. Hence, software entitled "Interactive Digital Image Processing System" (IDIPS) has been developed as user-friendly software for image restoration, enhancement and classification of Indian Remote Sensing Satellite digital data. The software IDIPS has been developed for Window platform. Microsoft Foundation Classes (MFC) in Visual C++ development environment is used to develop IDIPS. MFC is a library of C++ classes used to build Win32 applications. IDIPS make use of the various classes from MFC. One of the most important classes is CRSPPrjDoc that contains the data of the application. Further the class CRSPPrjView class displays the images formed by using the data stored in CRSPPrjDoc class. IDIPS allows user to restore an image and view various band images and false color composites. It also provides facility to perform linear and non-linear enhancement, edge detection, calculates vegetation indices. Distribution of data can be analyzed by viewing histograms. In classification, IDIPS provides the facility of supervised classification and hence allows user to select training areas of each land cover class. For each training site, the statistical parameters are generated. The classifiers used are minimum distance to means classifier, parallel piped classifier and maximum likelihood classifier.

(Guide: Dr.S.D.Sharma)

## 5. RITU MALIK - Development of Web Based Current Awareness Service for Library

Library serves as a Centre for arousing and stimulating intellectual curiosity and the desire to learn by offering materials and programs to satisfy the desire for knowledge. Current Awareness Service (CAS) of Library endeavors to keep the user informed promptly of all nascent thoughts created in their fields of work and related fields. One such service is “CURRENT CONTENT ON AGRICULTURE (CCA)” is brought out by IARI (Indian Agricultural Research Institute) library, in which Xerox copy of the content/index page of issue are bounded as a booklet and send to all the divisions of the IARI library. Keeping speed timeliness of CAS in mind, Web Current Awareness Service (WCAS) is developed as the Intranet solution to bring the CCA on the web and overcome its limitations, that is, time required reaching it to ultimate user. WCAS Software provides CAS for Journals, Books and Thesis. WCAS's, one of the silent features is to provide the list of Journal's Issue, which are procured by the Library between the two specified dates. WCAS allows its users to see the content/Index page of the recently procured issue. WCAS is developed using Java Servlets (server side programming) and JDBC (Java Database Connectivity), which makes it platform independent. WCAS is based on Windows DNA (Distributed InterNet Application) Architecture, divided into two parts namely, EndUser and Administrator (for library staff to update the information in the database). Through EndUser portion, WCAS provides three types of search facilities namely, Phrase/Keyword Search, Boolean Search and Combined Search.

(Guide: Sh.Mahesh Kumar)

## 6. SOUBHRATRA DAS - Web Based Information System on Integrated Pest Management of Cucurbits

Over the last few decades, the country has made impressive progress in the field of agriculture. Agriculture still remains the most vital sector in the economy of our country. It has become possible to minimize the losses in crop production due to infestation by the insects/pests, diseases, weeds and mites by using new technologies and research. The initiatives taken in the fruits and vegetables research to increase production and productivity in a sustainable manner can yield better results if information is readily available to the concerned. The information, which is available in the form of books, journals, magazines etc. can reach the common person if it is available in electronic format through the Internet. The present investigation was carried out with the idea of developing Integrated Pest Management Information System (CIPMIS) software that incorporates basic information on Major Cucurbits, its IPM and infestation by various insects, diseases, weed and mites. It has a three-layered architecture. It has been developed in HTML, JavaScript, Microsoft Access and Java Servlets & JDBC (the latest technology of Sun Microsystems). CIPMIS can be implemented as a network-based system with a server. There is provision to insert, update and delete the information.

(Guide:Dr.P.K.Malhotra)

## 7. V.V.SUMANT KUMAR - Development Of Web Based E-Choupal

Development of Electronic Chaupal is an attempt to increase the scope of the Chaupal, which means a forum where a group of persons (generally farmers) meet together and discuss issues of their interest. The main goal of this project is to give working solutions to farmers regarding various problems of crops. E-Chaupal is a combination of Non Virtual Reality Modeling Language (VRML) Chat Software, VRML Chat Software & Discussion Forums. The efforts are focused on the graphical user interface, which shall not be restricted to two-dimensional graphics, rather the farmer can experience a three-dimensional shared environment, in which he or she can navigate in a natural way. Its abilities are demonstrated on the concrete application of Electronic Chaupal. The E-Chaupal has been designed using object-oriented methodology and implemented using Java & VRML.

(Guide:Dr.S.D.Sharma)