

30 December 2016

**ICARDA**  
**Office of Deputy Director General-Research (DDG-R)**  
**Biometrics and Statistics Section (BSS)**

A report of trip to Hyderabad and New Delhi, 19 November – 27 December 2016 for ISAS Conference and Biometrics and Statistics Support to SA&C RP and Afghanistan Projects  
*by* Murari Singh

The report has three parts.

**Part -I**

- Organize and convene an Invited Session on Bayesian Statistics, and present a joint paper, 22 Nov 2016, Indian Society of Agricultural Statistics Conference at ICRISAT, Hyderabad [November 21-24, 2016 Biometrics and Statistics Section]

**Part -II**

- 1) To discuss manuscripts preparation and statistical analysis of data on micro-nutrients in lentil with possible GxE interaction-- Nepal, Ethiopia and Morocco; 2) Visit to Amlaha Research Station to understand experimental fields' configurations to control of variability within them, and Station database for crop information [November 25 – December 7, 2016, South Asia and China Regional Program].

**Part -III**

- To carryout statistical analysis of data from small ruminants and crop trials and discuss/write statistical components in the draft manuscripts [December 8-16, 2016, Afghanistan Country Program].

## Part –I

### i) Purpose of travel (A statement)

- Organize and convene an Invited Session on Bayesian Statistics, and present a joint paper, 22 Nov 2016, Indian Society of Agricultural Statistics Conference at ICRISAT, Hyderabad [November 21-24, 2016 Biometrics and Statistics Section]

### ii) Principal contacts with address (for a program database)

- Dr. Fred van Eeuwijk, Postbus 386, 6700 AJ, Wageningen, The Netherlands. Email: fred.vaneeuwijk@wur.nl
- Professor Jode W. Edwards, United States Department of Agriculture, Agricultural Research Service, Ames, IA, Corn Insect and Crop Genetics Research Unit. Email: Jode.Edwards@ARS.USDA.GOV
- Dr Anil Rai, Head & Professor , Center for Agricultural Bioinformatics, IASRI, ICAR, New Delhi. Email: anil.raai@icar.gov.in.
- Dr. Lucas Mueller, Associate Professor, Section of Plant Breeding and Genetics, School of Integrative Plant Science, Cornell University. Email: lam87@cornell.edu

### iii) Summary of the visit (2-3 paragraphs on the main activities of your visit only)

- Attended most of the presentations including those on
  - “Design of Experiments & Phenotyping”—new techniques for capturing spatial pattern in two-dimension; roles of repeated checks [these could be included if any non-statistical purpose is met] and replicated checks [not necessary if other entries are replicated for estimating experimental error variance]; and incorporating covariance for GxE interaction in multi-environment trials.
  - “Bioinformatics”- GOBII (Genomic Open-source Breeding Informatics Initiative); WYSWYG-DNA based variant data; Big data analysis in rice at IRRI; 3000 rice genome project; computational genomics approach for development of breed and variety signature system for agricultural germplasm management
  - “Open Sources Statistical Computing”—solGS: A webtool for Genomic Selection Analysis; Satellite Imagery and Spatio-temporal Big-data Challenges in Agriculture – Use of Geospatial technologies; mppR: an R-package for QTL mapping in multi-parent populations using linear mixed models
  - “Intelligent Cloud and Data Science to Transform Agriculture”
  - “Big Data Analytics”- Views from Statistical and Computational Perspectives; Building Efficient Weather-based Agricultural Decision Support Systems; Developing Big Data Analytics Architecture; Statistical Analysis of High-dimensional Metagenomic Data with Applications in Agriculture
  - “Data Management”-- Enhancing Discoverability and Re-use of CGIAR’s Agricultural Data: Challenges and Progress; Managing geospatial database of harmonized, multidisciplinary agricultural indicators for big data analytics in Africa South of the Sahara; Cassavabase – a web-based enterprise-level breeding database for Cassava and other crops.
  - “Geostatistics & Remote Sensing”-- Mapping suitable areas for growing pulses in rice-fallows using multi-criteria spatial decisions; Analysis of Landsat-based Water Use Estimates (1984-2014) in the Southwestern United States: An Illustration of Big Data Analytics for Agricultural Remote Sensing; Image Stitching: Reliable base layer for field level studies; Geo-Statistics and Remote Sensing -Testing Plant Diversity and Environmental Heterogeneity Hypothesis in India; Space Technology based Governance of Watershed Management: Perspectives and Issues in Indian Context
  - “Statistical Modelling & Forecasting Convener” -- Statistical models used for forecasting of food grain production in India; Statistical Modeling of Meteorological Data and its Applications in Weather Based Crop Insurance Schemes for Banana; Models in agriculture: use of mechanistic

- modeling approaches to accelerate breeding
  - “Statistical Genetics & Genomics: -- Genomics based Next Generation Crop Improvement Approaches; A Machine Learning approach to find genetic diversity in Rice Genome Variants; Data Science Applications in Genomics; Mapping of quantitative trait loci in cassava using Markov chain Monte Carlo (MCMC) method
- Convened the session on “Bayesian Statistics” and presented the joint work on Afghanistan project:
  - Improving Decisions in Plant Breeding with a Bayesian Approach; Applications of Bayesian Computing in Modelling of Agricultural Data; Bayesian Modelling: A Few Related Issues; A Bayesian analysis of data from on-farm trials in legumes in Afghanistan

#### **iv) Implications for ICARDA**

- Plant breeding data management: A complete tools for breeding trials including experimental design, field book, DM, Analysis, Genomics tools. Dr Lucas Mueller can be contacted to share his knowledge with BIGM staff, particularly from the International Nursery. Further details are available at: <http://bti.cornell.edu/research/projects/cassavabase-project/>; <http://www.nextgencassava.org/index.html> <https://www.cassavabase.org/>

## Part –II

**Period: November 25 – December 7, 2016**

**Purposes:** 1. To discuss manuscripts preparation and statistical analysis of data on micro-nutrients in lentil with possible GxE interaction-- Nepal, Ethiopia and Morocco; 2. Visit to Amlaha Research Station to understand experimental fields' configurations to control of variability within them, and Station database for crop information.

### **Activities:**

- Prepared the manuscripts (revision of an earlier version of the manuscripts, inclusion of abstracts, results, discussion)
  - “Genotypic variability and GxE interaction for the micro-nutrients Zn & Fe in lentil cultivars in Nepal” (Shrestha et al.)
  - “Reducing anti-nutritional factor and enhancing yield with advancing time of planting and zinc application in grasspea in Ethiopia” (Sarker et al.)(Draft Manuscripts available.)
- Carried out Statistical analysis of “Lentil seed dissemination survey data from Bihar”—introduced a coefficient to indicate Distress Sale (DSC), Screened socio-economic variables associated with DSC and productivity of grain and seed. Genstat codes and resulting outputs given to Dr Dogra.
- Visited ICARDA-India Platform and Research Station at Amlaha, seed storage/processing facilities, Demonstration trials at the station and experimental fields, and on-farm trials in farmers fields, Amlaha. (Interacted with Dr Gautam, Dr RP Singh, Dr Rizvi, Mr Tomar and Mr Sunil).
  - The ICARDA-India Platform is well equipped with critical components of a research station carrying more activities than by a limited staff. While there are smart office-workstations in place, a modern meeting room, seed-store, spaces for essential field machineries, etc. however, the other existing spaces/rooms will need renovation.
  - Demonstrations plots for chickpea, lentil and barley: The two other factors that are likely to influence the comparison between rainfed and irrigated genotypes/plots are the sloppy land (moisture differences) and distance from the trees. For the next season, following is suggested: Irrigation vs rainfed should be in nearby land segments across the genotypes, i.e., rainfed (irrigation) up (down) the slope and this will minimize soil fertility differences and the alleys should be covered by a representative crop genotype.
  - Research Information System: Amlaha Research station's field-blocks may be mapped for their spatial position. The Research Informatics is needed for creating, storing and retrieving, reporting the station field/plot data and web display.
- The barley trials: Suggested designs are either 1) augmented design with replicated checks or 2) p-rep designs with un-replicated and genotypes with two and more replications. Systematic checks may be kept if they serve any purpose [other than estimating experimental error variance].
- Discussed and finalized the traits to be included, the tables and the trees-plots to be commented in preparation of the manuscript:

“Genetic variability and heritability of agronomic traits in 3102 selected chickpea (*Cicer arietinum*) lines” (Barpete et al.)

- The introduced Online BioComputing system and the procedure of submission was explained to four participants (VK Tomar, Sunil Kumar, S Barpete, A Rizvi) for the design Augmented, analyses—RCBD, IBD, SPUR.
- Visited the farmers fields (7 Dec 2016, led by Dr RP Singh) for crop stands, learned of the organic seed treatments, cropping systems and planting systems, participated in the Workshop organized by the Farmers in Tichodiya Village, exhibits of locally made tools for fruits utilization, and shared views on their innovations and need for keeping quantitative information/data for knowledge management. Establishment of mini-industry to process grain legumes was felt as a need to help farmer develop products in the village itself. The farmers were very progressive, periodically sought expertize of the Agricultural University (e.g., Dr RP Singh) and shared know-how among themselves.
- Visited (7 Dec 2016) legume bio-diversity collections and seed quality lab, Genebank (for 5000 accessions) and exhibits on seed certifications and rolling plans for research and development for legume production (Profs Yashin, D. R. Saxena and Joshi, Rafi Ahmed Kidwai College, Sehore of Rajmata Vijayaraje Scindiya Krishi Vishwa Vidyalaya, Gwalior)  
(More details in the Appendix-1.)

14 -15 Dec 2016 (parts of the days)

- Participated in the “Inception Workshop of IFAD-ICARDA Regional Project in South Asia: Enhancing Food and Nutritional Security, and Improved Livelihoods through Intensification of Rice-Fallow System with Pulse Crops in Bangladesh, India & Nepal”, 14-15 December, 2016 (NASC Complex, Dev Prakash Shastri Marg, Pusa, New Delhi-110012, India).

**Period: December 8-16, 2016**

**Purpose:** To carryout statistical analysis of data from small ruminants and crop trials and discuss/write statistical components in the draft manuscripts [December 8-16, 2016, Afghanistan Country Program].

**Activities:**

Worked with Afghanistan colleagues on:

1. Goat data: To evaluate effect of feeds on final body weight, milk yield and quality  
ANOVA (with covariate adjustment of initial body wt), means, SE, p-value, MCP, and repeated measures.  
(Srini)  
(Modelling of covariance structure with random coefficients for Nangrahar datasets will be carried out later.)
2. Watershed experiment: to study the effects of an number of water-harvesting structures and sizes on tree establishment and biological parameters.  
Randomized plans for an RCBD with 9 treatments (2 diamond shape and 2 semi-circular shape and their two sizes (4m, 6m) and a local control) was given (Nigamananda and Srini)
3. Experimental designs for the following trials (Daryakhan/DK and Lina Mohammadi/LM)  
Wheat: seven multi-location-trials planted November 2016 were reviewed. (DK)  
Chickpea: six multi-location-trials planted November 2016 were reviewed. (LM)
4. Analysis of wheat and chickpea trials for manuscript preparation and annual reports  
Wheat: Analysis of two-year multi-location for three trials discussed and table formats agreed. (DK)  
Chickpea: Analysis of two-year multi-location for two trials discussed and table formats agreed (LM)
5. Analysis of demonstration trials in wheat: summaries and t-tests (DK & LM)

## Appendix-1

### 6 Dec 2016

In most of the visits to learn, I interacted with the ICARDA Team -- Dr VK Gautam, Dr S Barpete, Dr A Rizvi, Mr VK Tomar, and Mr Sunil Kumar.

The ICARDA-India Platform is well equipped with essential features of a research station carrying more activities by a limited staff. The large part of the College infrastructure well renovated with office workstations in place, a modern meeting room (also suited for a training course for 15 participants), seed-store, spaces for essential field machineries, etc. however, more spaces/rooms will need renovation.

1. Demonstrations plots for chickpea, lentil and barley: Interaction with Dr Gautam, Dr Rizvi, Mr Tomar and Sunil. These plots are meant for demonstrating variety contrasts due to irrigation vs. rainfed but separated by a long distance. The two other factors that are likely to influence the comparison are the sloppy land (moisture differences) and distance from the trees. For the next season, following are suggest:

- Irrigation vs rainfed should be in nearby land segments across the genotypes, i.e., rainfed (irrigation) up (down) the slope and this will minimize soil fertility differences.
- Cover the alleys by a representative crop genotype
- Effects of plot distances from the nearest tree are also needs to be evaluated before including in the design.

GU: Amlaha Research station's field-blocks can be mapped with GPS. The Research Informatics is needed for creating, storing and retrieving, reporting the station field/plot data and web display.

2. Seed stores

(Led by Dr Gautum) Seed grader working on gravity to segregate heavy-clean vs light-unclean seeds of lentil and other legumes, impressive and reasonable precision, cost INR5000 (US\$75), standalone, no electricity needed. However, this seed store will need additional shelves and racks to organize the seed packages and temperature control facilities.

The neighbouring room has been assigned for creating a Training Center.

3. Machineries

(Led by Dr Gautum) Daal Mill crushes the legumes seeds for daal and auto-seals into packets, available for sale, packaging.

CIAE (Central Institute of Agricultural Engineering), Bhopal: manual and automatic for seed grading.

Planters for seeding (even spacing of seeds within row), rows within plot, uses seed packages as per the randomizations chosen; Raised-bed planter; Seed threshers for harvested plot (cloth bags); Rotavators for refining the soil crusts; multi-seed threshers and zero-till drill.

4. Un-replicated field trials in barley

(Led by Mr. Sunil Kumar) Four sets of un-replicated trials in genetic materials with different phenology, mapped by the sowing dates.

- Planting date 1 Nov 2016 (220 plots, VMorales as repeated check, after every 14 test entry,  $20 \times 11$  (N- E/col  $\times$  W-S/row) layout, plot size- 0.5 m long 4 rows)
- 10 Nov 2016 (620 plots, Rihani repeated as checks after every 20 th entry,  $20 \times 31$  layout)
- 20 Nov 2016 (480 plots, JV58 check repeated every 20 entry,  $20 \times 24$  layout)
- 30 Nov 2016 (100 plot, DWRB73, every 13 entry,  $20 \times 5$  layout)

The plants were well germinated/visible in the first three dates, those under the forth one are still mostly invisible.

Suggestions: The above scheme cannot estimate experimental error variance. If systematic check is helpful then keep it, but in addition please use either 1) augmented design with replicated checks; or 2) p-rep designs with unreplicated, materials with two and more replications; and use the Spatial method of analysis (ICARDA Online BioComputing Module: SPUR)

5. Replicated Field trials

Fields 22 and 23: Led by Surendra: 6 chickpea replicated trials in simple lattices or alpha designs with two replications (CIEN-S-17, CIEN-LS-17, CICTN-17, CIDTN-17, DAC Selection, Chickpea selection) and a Single plant selection trial (870 plants- 44 blocks of 20 entries + 2 checks per block). These designs slope differences less visible within blocks but seems confounded with blocks.

Field 36: DAC 135 genotypes selected from 3000 lines during 2014-15 and 2015-16 for multiple traits, in  $15 \times 9$  (9 blocks) 2 reps.

Grasspea selection 2015-16 in a simple  $8 \times 8$  lattice.

The replicated designs are efficient. Analysis module: SPIB is suggested.

Cactus trials:

- 1) Multiplication of 24 species
- 2) Effect of 4 sowing dates, 2 fertilizer (+, -), irrigation (+, -) on a single species; factorial in RCB with 2 reps. Observations on # of pads.

6. Preparation of the manuscript

“Genetic variability and heritability of agronomic traits in 3102 selected chickpea (*Cicer arietinum*) lines”

Discussed and finalized the traits to be included, the tables and the trees-plots to be commented.

7. Online BioComputing

The introduction and procedure of submission was explained to 4 participants (VK Tomar, Sunil Kumar, S Barpete, A Rizvi) for the design Augmented, analyses—RCBD, IBD, SPUR.

8. On-farm demonstration trials. Led by VK Tomar

Visited a total of 4 on farm trials in village Amlaha.

Farmer 1: The grasspea variety Mahateora developed by Krishi VV, Raipur and being promoted by ICARDA due to low B-ODAP content (also has pink color), suited to rainfed condition.

Farmer 2 (Mr Balram Singh). Lentil improved variety Pusa Vaibhav being promoted by ICARDA for its high level of micro-nutrients Fe and Zn (Area= 1 acre== 0.4 ha)

Farmer 3 (Mr Gajraj Singh Varma/Santosh Varma). Pusa Vaibhava; good stand, short height. Area=1 ha

Farmer 4 (Mukesh Varma). Pusa Vaibhav, two fields (total 1 ha).

On-farm trials on improved varieties from JKVV but promoted by ICARDA

For the ongoing Rabi season (October – March) 2016-17, 200 farmers were given seeds with cultivation package for demonstration of lentil, chickpea and grasspea. The information returned could also through light on seed dissemination from farmer to farmer.

**December 7, 2016**

Visits to farmers' fields and to participate in Farmer – RAK College organized Meeting in village Tichodiya  
Organiser Dr RP Singh, RAK College of Agriculture, RVSKVV, Sehore, MP. Dr RP Singh is the research contact for several villages, keeps regular visits to the fields and advises the farmers on the seeds, seed treatments, land preparations, crop production, protection and any other component of the agric technology.



Scientists met: Dr RP Singh, Dr Yasin, Dr DR Saxena

### **Village: Deeda Khend**

Field 1: Grasspea variety Maha Tevda, well established, good growth (Farmer: Mr Mahendra Singh).

Field 2: Chickpea on raised bed (3 rows per bed) using raised-bed planter for IRs22000 (at 80% discount by MP Govt.). Low effect of wilt. Much healthier growth compared to that under normal planting in the other side in the same large field. Mr Bhagat is an innovative farmer and has introduced organic seed treatment using cow urine, lime and dung to control effect of wilt and other diseases.

Field 3: under P992, a pigeon-pea variety from RAK College, Sehore.

Field 4: Kripa variety of Kabuli chickpea developed in Rahuri, bold seed, 55-60 gm/100-seeds, broad leaf, mixed cropping with coriander to control *Helicoverpa*/ pod borers (Area: 1.5 acres); In a part of the field: irrigated barley.

Field 5: Wheat variety 1544 (Area 4 ha)

Mahendra (President of the society), Balram (chief of a farmer group) and Bhagat are progressive farmers share their knowledge on the crop production technologies they apply.

### **Village: Tichodiya Lakha**

Field 6: Mr Narvada Prasad Shriram, village: Tichodiya Lakha, Chickpea in good growth (told due to see treatment)—maize plants in the field to facilitate birds perching and easily catch the insects on the chickpea plants.

Field 7: Mr Motilal brother of Mr Hazari Lal. Three legumes: Chickpea (0.5 ha), lentil (1 ha) and pigeon-pea.

Field 8: Kabuli chickpea-JGK3, uniform flowering, good growth (1 ha)

Field 9: Desi chickpea, pink flowers, good growth (1.5 ha). Options: wheat if 2+ irrigation available.

Field 10: Kabuli chickpea- KAK 2, seed treated with beta vax; early maturity and high branches. Cropping system: Early soyabean variety- 1960 (Jun – mid-Oct) – chickpea KAK2 (Oct – Feb) – Onion/fodder crop (March +) [Mr Balram]

### **Krishak Gosti (Farmer Meeting and Demonstration of seeds, fruit products and tools) at Tichodiya Lakha**

A meeting and workshop to share experiences of the farmers by the farmers and to demonstrate tools, seeds and food products was organized by Dr RP Singh. On display in open were seeds of chickpea and lentil, muabba and aachars from aamla, lemon, mechanical tools to prepare potato chips, clean-removal of aamla seeds, coconut crusher, multi-piece cutter etc. were demonstrated by Drs Sharma and Saxena. Inside the tent were posters displayed. Brochures and pamphlets were available. There were over 40 participants present including 10 students in agricultural education. Speakers were: Bhagwat Singh Patel (Chief Guest), VS Gautam, Aqeel Rizvi, Chaudhari, Murari Singh, RP Singh Sharma, Saxena (convener). Manohar Singh and Manohar Lal narrated their experience of dealing with pesticide quality. Expectation from ICARDA: Chickpea variety tolerant to low temperature were needed.

**Under tree shade near a well:** Mr Manohar Singh and Mukhatir Singh. Earthworm being used to prepare organic fertilizer – wet leaves, cow dung, earthworms, kept in shade.

Field 11: Kabuli chickpea- Kripa (0.5 ha)

Field 12: JKM-189 pigeon-pea intercropped with wheat

Field 13: DBW-110 wheat-- Sarwati

Field 14: Chickpea variety Kripa: tall, thick canopy, broad leaf, large pods, good growth, seed treatment beta vax (1.5 ha)

Field 15: Cropping system: Soya bean in Kharif season- pigeon pea (variety JKM 189) intercropped with chickpea (variety JG 11) in 2 rows : 10 rows in Rabi season. JKM 189 is tolerant to pod borer.

**Rafi Ahmed Kidwai (RAK) college, Sehore** (Rajmata Vijayaraje Scindiya Krishi Vishwa Vidyalaya, Gwalior)  
Met Profs Yashin, D. R. Saxena and Joshi and team, visited legume bio-diversity collections and seed quality lab, Genebank (for 5000 accessions) and exhibits on seed certifications and rolling plans for research and development for legume production (explained by Dr Yashin).

**College-farm demonstrations and trials:**

Diverse lines of chickpea, including those suited for mechanical harvesting (1<sup>st</sup> pod height above 20 cm), 110-115 DAM, JG-11 (105 DAM) at Sehore.

Wilt sick-plot for screening for fusarium wilt resistant chickpea.

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