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

A Report of BSS Activities During 2015

Activity titles:

1. Advisory Support to Research Projects (BSS-1)

2. Exploitation of Advanced Biometrical and Statistical Techniques (BSS-2)

3. International Crop Information System (ICIS) Support (BSS- 3)

4. Bioinformatics Support (BSS-4)

5. Biometrical and Statistical Computing (BSS-5)

6. Statistical software, data management and analysis (BSS-6)

7. Training (BSS- 7)

8. Support to DDG-R Office (BSS-8)

(Prepared January 2016)

<u>Biometrics and Statistics Support During 2015 by Murari Singh</u>

1. Advisory Support to Research Projects (BSS-1)

Delivered biometrics and statistics support to the scientists and students on experimental design and statistical analysis, developed computing codes and carried out data analyses, helped in drawing inferences, suggested on presentations and conducted statistical reviews. The services were provided for the following research program activities:

CRP Dryland Systems

Reviewed the following 2015 Workplan documents and offered suggestions on the sample surveys including
- CRP DS Workplan documents submitted for the flagships (WANA) and identified the list of survey activities to be under taken (NAWA, WAS&DS, E&SA, SA, CA.
- Questionnaire (CA) and contributed to the questionnaire "Baseline survey for CRP Dryland Systems for CA"
- "CGIAR Research Program on Dryland Systems, 2014 Annual Performance Report", planned for submission to CGIAR Consortium Office, 10 March 2015.
- Survey questionnaires on activities, including gender contribution, on community structure, labour service providers, collectors, processors and producers, in Mahon and Sayaga action Sites in Burkina Faso, WAS.
- Discussed with Bao and Chandra on identifying the spatial units for compiling data on environmental, bio-physical and socio economic variable to examine their [units'] similarity using mixed methodology

Contributed to development of a **project proposal** [discussion and inputs were given in the DRAFT documents]
- "Climate Change, Agriculture and Migration in the Maghreb Region: a Threat for European Security"
- "Building evidence of labour market impacts on women and youth in the Middle East and North Africa"

CRP Wheat
- Re-designed and developed jackknife estimation of genotypic, GxE interaction, phenotypic correlations from data in RCB (complete block designs), IBD (incomplete block designs), and their multi-environment trial versions (RCBMETs and IBDMETs).[W. Tadesse]

Legumes: CRP Grain Legumes/ CRP A4NH /Bilateral projects
- Spatial variability of field trials in lentils: Revision was carried out in the light of comments such as new approach of assessing closeness between the heritability estimates. [A Sarker]
- Revised the manuscript "Evaluation of faba bean breeding lines for spectral indices, yield traits and yield stability under diverse environments" by Maalouf et al. for the comments from reviewers of Crop and Pasture Science. [Fouad Maalouf]
- Contributed in write-up of the DRAFT manuscript for Euphytica. [Fouad Maalouf]
- Revised the DRAFT "Genetic variability for nutritional quality in Lentil (*Lens culinaris* Medikus Subsp. *culinaris*)" by Sarker et al.
- [to continue] Analyzed and summarized CIEN-winter data for association with climatic

variables with a view to study climate change effect. [A. Hamwieh, C. Biradar]
- Supervised (continuing) data checks on multi-locational replicated trials in RCBD on chickpea, lentil and mung bean. [Yashpal Saharawat, YS]
- Analysed on-farm demonstration trials in chickpea. Updated the DRAFT manuscript on "Enhancing food security by introducing improved variety of food legumes in Afghanistan" [YS]
- Analysed on-farm demonstration trials in mung bean. [YS]
- Analysed chickpea data from an RCBD (CICTN), where check plots were repeated every two test entries. There were two complete blocks for the tests. Adjustments were made for mini-local linear trends and ANOVA was carried out on the adjusted values along with other standard analyses for comparison [YS]
- India NARS: Analysis of lentil data on grain Fe and Zn of all 314 lentil genotypes, from 4 environment in India. METCB used. [A. Sarker]
- Analysis of Lentil IARI NIRS data [A. Sarker]
- Carried out an AMMI analysis on chickpea data from RCBD with missing values. [Ala Hamwieh]
- Analysis of data on chickpea leaf miner at two environments, Douyet-2015 and Marchouch-2014 in Morocco and a short write-up for M&M. [Ph. D. degree student Abdelhadi Sabraoui/Mustapha El Bouhssini]
- Analysis of data from a project on "Efficacy of contact and systemic insecticides on mint crop in Morocco", 2012-2014 at Morocco. (Analysis of time-point responses and repeated measures for time x treatment interaction, modelling of the dynamics of response and comparison of treatments). [Mustapha El Bouhssini]

CRP Dryland Cereals/barley bilaterals
- High input barley (HIB) trials 2014 data analysis. Developed Data analysis plan, Data management, Wrote Genstat codes for analysis (variance components, heritability, genetic gain, BLUPs) for individual trials. [RPS Verma]
- Developed a draft manuscript on "Identifying barley genotypes for optimum input conditions in the NAWA Regions" Verma et. al.
- Analyzed data, from augmented design, on agronomic and micro-nutrient traits to describe variability/diversity, correlation between traits, clustering of genotypes and ordering them using PCA. [Sanjaya Gyawali]
- Fe and Zn data analysis [Sanjaya Gyawali]
- Submitted BSS components in clusters of activities for 2nd Call for DCLAS proposal [RPS Verma]
- Revised the manuscript "Genetic variation in winter barley and selection of high yielding lines" by Adnan Al-Yassin et al. for publication in the Indian Journal of Agricultural Research [A. Al-Yassin]
- Contributed to the DRAFT manuscript on "Genetic variability in agronomic traits and micronutrients in Kernel of wild and cultivated barley germplasm of ICARDA" by Gyawali et al. prepared for Euphytica. [Sanjaya Gyawali]
- Contributed to the manuscript "Genome Wide Association Mapping for Yield and Yield Components in Jordanian Barley (Hordeum vulgare L.) Landraces Grown under Drought-Prone Conditions" by A. Karadsheh et al.[A. Al-Abdallat, N. Haddad]

IWLM/WLE/bilaterals
- Analyzed data on olive land and water productivities on seed and oil yields from the trials in Syria and Morocco; a write-up on M&M and interpretation of results. Programme for the

Development and Dissemination of Sustainable Irrigation Management in Olive Growing. [Vinay Nangia]

SU
- Reviewed and contributed to the manuscript "Impact of grazing management … diversity, Syria"; designed reanalysis plan to revise the manuscript in the light of comments from "The Journal of Arid Environments" [A.A. Niane]

BSS
- Document prepared: Draft "2016-2020" ICARDA Strategy for Biometrics and Statistics Support to Research: Enhancing Research Quality for Innovation and Knowledge Sharing in Agri-Food Systems

Statistical Reviews

Reviewed over 8 manuscripts submitted for publication in various scientific journals.

Scientists have used the suggested experimental designs and the statistical analysis outputs were used in interpretation of results and publications.

2. Exploitation of Advanced Biometric Techniques (BSS – 2)

With a view to develop knowledge products as publications, I developed statistical analyses strategies/outlines in discussion with concerned scientists, examined datasets, computing wrote (mainly) Genstat programs, carried out statistical analyses and wrote biometrics and statistics component in the Materials & Methods and other sections of the manuscripts (partly common with BSS -1).

Innovations:
- Bayesian approaches GxE interaction studies

These and other work led to the preparations of following documents:

Published

- Adnan Al-Yassin, Murari Singh and Michael Baum (2015). "Genetic variation in winter barley and selection of high yielding lines" Accepted in Indian Journal of Agricultural Research, 49(6): 481-488. DOI: 10.18805/ijare.v49i6.6673
- Siraj Osman Omer, Abdel Wahab Hassan Abdalla, Mohammed Hassan Mohammed, Murari Singh (2015). Bayesian Estimation of Genotype-by-Environment Interaction in Sorghum Variety Trials. Crop Biometry and Crop Science, 10: 82-95.
- Maalouf, F., Miloudi Nachit, Michel Edmond Ghanem and Murari Singh (2015) Evaluation of faba bean breeding lines for spectral indices, yield traits and yield stability under diverse environments. Crop and Pasture Science 66:1012-1023. http://dx.doi.org/10.1071/CP14226
- Sarker, A. and Singh, M. (2015). Improving breeding efficiency through application of appropriate experimental designs and analysis models: a case of lentil (*Lens culinaris* Medikus subsp. *culinaris*) yield trials. Field Crops Research 179: 26-34. (doi:10.1016/j.fcr.2015.04.007)
- Arslan, A., G.A. Majid, M. Hamdan, P. Rameshwaran, R. Ragab, M. Singh, and M. Qadir (2015) Evaluating the Productivity Potential of Chickpea, Lentil, and Faba bean under Saline Water Irrigation Systems. Irrigation and Drainage. (doi:10.1002/ird.1912)

- Scott Christiansen, John Ryan, Murari Singh, Serkan Ates, Faik Bahhady, Khalil Mohamed, Omran Youssef and Stephen Loss (2015). Potential legume alternatives to fallow and wheat monoculture for the Mediterranean environments. Crop & Pasture Science, 66: 113–121. http://dx.doi.org/10.1071/CP14063.
- Murari Singh, Adnan Al-Yassin and Siraj Omer (2015) Bayesian Estimation of Genotypes Means, Precision and Genetic Gain due to Selection From Routinely Used Barley Trials. Crop Sci. 55(2): 501–513. (doi: 10.2135/cropsci2014.02.0111).
- Patil, P, D. Dutta, C. Biradar, M. Singh (2015). Quantification of the terrestrial phytomass and carbon in the mountainous forest ecosystem using remote sensing and in-situ observations. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-7/W3: 483-487. (doi:10.5194/isprsarchives-XL-7-W3-483-2015). Presented by P. Patil at 36th International Symposium on Remote Sensing of Environment, 11–15 May 2015, Berlin, Germany.

Accepted for publication

- Omer, Siraj Osman, Abdel Wahab H Abdalla and Murari Singh (2015) "Bayesian estimation of genotypic and phenotypic correlations from crop variety trials" in Crop Breeding and Applied Biotechnology (to appear)
- Chaubey, Y.P., Sarker, A. and Singh, M (2015). Power Transformations: An Application for Symmetrizing the Distribution of Sample Coefficient of Variation from Inverse Gaussian Populations. Accepted as a book chapter in Taylor & Francis publication
- Singh, M., A.B. Damania and Y.P. Chaubey (2015) Submitted a manuscript "Plant Genetic Diversity: Statistical methods for analyzing distribution and diversity of species" Accepted as a book chapter in Taylor & Francis publication.

Technical Reports/Submitted for publication/Draft of publications

- Singh M., A. Sarker and W. Tadesse (2015). Estimating precision of genotypic correlations from multi-environment crop variety trials using the jackknife method illustrated with lentil and wheat data (Version 2). Biometrics and Statistics Technical Report 1(2015).
- Contributed to a draft manuscript by Fouad Maalouf, Seid Ahmed, Khalil Shaaban, Bayaa, Bassam, Fawzi Nawar, Murari Singh, Ahmed Amri. (2015). New faba bean germplasm with multiple resistance to Ascochyta blight, Chocolate spot and rust diseases.
- Writing input to the draft manuscript by Omary, J.E., Tulaymat, M.F., Singh, M., and Biradar, C. (2015). Mapping and monitoring of agricultural production systems for the better interventions of crop management. At an invited special session on "Agricultural ecosystem monitoring, assessment, conservation, and service sustainability", The Fourth International Conference on Agro-Geoinformatics- 2015 - Istanbul, Turkey.
- Contributed to a draft manuscript by Prashant Patil, Chandrashekhar Biradar, Layal Atassi, Rachid Moussadek, Mohamed Kharrat, Murari Singh, Fouad Andaloussi and Shiv Kumar Agrawal (2015). Mapping and Monitoring of Food Legumes and Dryland Cereal Production Systems" for "The Fourth International Conference on Agro-Geoinformatics 2015 - Istanbul, Turkey"

Collaboration with NARS/CG Center

Continued.
- Professor Y.P. Chaubey, Concordia University, Montreal (Theme: Power transformation of CV, diversity of plant species)
- Dr Rajender Parsad, Head, Division of Design of Experiments, IASRI, New Delhi (Theme: GenStat codes on analysis of crop rotations trials and training)

- Dr. Abhishek Rathore, Biometrician, ICRISAT (Theme: Spatial Analysis, R-codes)

Contributed to the innovations, to enhanced research data-quality, and preserve the intellectual property of the Center and to the enhancement of the science quality as acceptable to the peer-reviewed publications.

3.3 International Crop Information System (ICIS) Support BSS –3
ICIS maintenance and development support
- Discussed on organizing databases on experimental responses/summaries with spatio-temporal information; aiming at Climate Change studies (Andrew and Chandra), broad summaries were prepared for chickpea and lentil trials at TH, Breda and Terbol (incomplete).

3.4 Bioinformatics Support BSS-4
To provide bioinformatics support for developing Genetic Resources, Crop and Genomic Information and Analysis Systems at ICARDA
Biotechnology
- Developed an R program for comparing populations for total alleles arising from several markers. In addition to the permutation test, also included normal approximation using square-root transformation on $(x+3/8)$. [S. Udupa]

5. BioComputing (BSS- 5)

Developed, besides the specific coding required in the statistical consultancies at users will to carry out the analysis, including the following:
- RCBD module (includes heritability on mean basis, residual plots and multiple comparison test using Bonferroni and Tukey tests)
- IBD module (includes heritability on mean basis, variance components, plots and multiple comparisons
- MET CB module (includes heritability on mean-basis and genetic gain)
- MET IB module (includes heritability on mean-basis and genetic gain)
- SPCB module (includes heritability on mean-basis and genetic gain)
- SPIB module (includes heritability on mean-basis and genetic gain)
- SPUR module (includes heritability on mean-basis and genetic gain)

6.Training (BSS-7)

Conducted the following courses/workshops for the NARS and ICARDA scientists/technicians with following titles and dates:

1. **Statistical Design, Data Management and Statistical Analysis in Agricultural Research in Afghanistan**, 8-12 March 2015, ICARDA, Amman, Jordan. (3 participants including a woman participant from Afghanistan.
2. **Design and Analysis of Water Resources Experiments** (a lecture on 18 May) in the training course "**Improving Agricultural Water Productivity** (with emphasis on irrigated production systems), 3 – 21 May 2015, ICARDA, Amman, Jordan (12 participants)
3. **Design and analysis of legume variety trials**, 21 May 2015 as a part of **Specialized Training Course on Food Legumes Improvement**, 17 – 26 May 2015, Tal Amara- Terbol, Lebanon (18 participants). Trip report available.
4. **Statistical Presentations** (8 September 2015) as a part of training course on **Achieving**

Success with Technical Scientific Writing, 8-10 September 2015, ICARDA, Amman, Jordan (20 participants).

5. **Statistical Design, Data Analysis and Biometrical Techniques in Agricultural Research**, 8-12 November 2015, Amman, Jordan. 10 participants [Jordan (2), Sudan (4), Palestine (1), Egypt (1), Tunisia (1), Lebanon (1)]

6. **Data Management, Basic Statistics, Field-plot Techniques, Experimental Designs and Statistical Analysis**, 16 – 27 November 2015, ICARDA, New Delhi (Specifically designed for agricultural researchers from Afghanistan). 8 participants (Afghanistan-5, India-3).

7. **Advanced Biometrical Techniques in Crop Improvement Research**, 30 November – 9 December 2015, New Delhi, India. 13 (including 2 women) participants (Bangladesh-3, Nepal-3 and India-8).

8. **Design and Analysis of IPM experiments on Date Palm** (23 December 2015) as a part of the training course on "**IPM of Date Palm Pests**", 20-23 December, 2015, Al-Ain, Abu Dhabi, UAE (organized by Drs Azaiez Ouled Belgacem and Mustapha El-Bohssini). 20 (including 4 women) participants.

ICARDA In-house course

9. **Data analysis using Genstat,** 4-22 Oct 2015 (14-16 hr, 12 sessions in total), ICARDA, Amman, Jordan. Aim: To Enhance Science Quality. (1-4 scientists). Topics: Introduction to Genstat software, Introduction/Excel/ ANOVA/Regression; Data Management, use of in-house developed Online BioComputing modules; Basic statistics - descriptive statistics and tests of significance of mean(s), variances and proportions, determination of sample size for estimation of means and proportions, Examples/Menus; A case study: Sardinia, Italy data analysis—degraded range lands- Objective of study, General ANOVA, Treatment and Block structures, interpretation; Basic Principles of experimental designs, design and analysis the Water Resources Management and Cropping System experiments using RCBD (one factor, two factors), Split-plot and strip- plot type designs; Grazing Experiments— analysis of repeated measures data; Regression analysis—simple, multiple, comparisons over a grouping factor levels.

   (Total number of participants in the above 9 courses: 108)

NARS Degree students and non-degree participants

1. Siraj Osman, Sudan: Reviewed his thesis, and manuscripts for publications, communicated with SAS Administration and monitored examinations. Siraj completed his Ph. Degree in May 2015.

2. Miss Aline Abou Naoum, Lebanon: a student registered for an M. Sc. degree with of Dr. F. Maalouf. Discussed analysis of her experimental data, reviewed experimental design, analysis procedure using REML, residual plots generated, data update advised

3. Ms Zeinab Ghareeb, Egypt: Advised on estimation of heritability from METs, estimated heritability on mean basis for data in an alpha design. (March – May)

4. Yousif Mohamed Abdelrahman, Ph. D. Student, Sudan: Data analysis of two experiments on wheat to evaluate effects and interactions of Sowing methods, cultivars, water amount and herbicide treatment (Split-split-split-plot design in RCBs and combined over two years).

8. Support to DDG-R Office (BSS- 8)

• Rendered executive assistance to DDG-R in preparation of documents containing information/statistics for Strategic Planning and Management decisions: summary tables on Decentralization of investment in equipment; tables of Programs x CRP Output/Workplan 2015; tables on land required for experiments; participated in Annual Planning Meeting, 1-4

Feb 2015, and noted/prepared the Minutes of these Meetings; presented the summary of feedback of a Working Group on Dryland Systems on theme "Improving and stabilizing system productivity through diversification and intensification" (1 Feb 2015).

Biometrics and Statistics Support During 2015 by Khaled El Shama'a

Biometrical and statistical supports to research projects of the center (BSS-1 & BSS-5)

- Worked with 3 ICARDA scientists/researchers to analysis their own experiments data:

    o Check, validate, and analysis data of Herbicide Screening-Aline's trial-2015 using SPIB bio-computing online module requested by Dr. F. Maalouf.

    o Check, validate, and analysis data of BLUP Morocco and Terbol trials using MET Means bio-computing online module requested by Dr. F. Maalouf.

    o Analysis Augmented design data set (6 trials, 17 traits, and 157 genotypes) requested by Dr. A. Hamwieh.

    o Discuss and analysis current International Nursery focal point challenges in data entry and retrieve procedures requested by Dr. A. Niane.

- Generated 33 randomizations (29 Alpha, 4 RCB).

- Processed 7 bio-computing online analysing requests (1 AUG1Way, 1 IBD, 2 SPIB, 2 SPUR, 1 MET Means) including checking related data validity and integrity.

- Worked with 6 MSc and PhD students to perform requested analysis for their theses:

    o Analysis fungi greenhouse & characterization trials using ANOVA, transformation, Duncan, and AUDPC requested by Ammar Bayaa (Dr. M. Baum M.Sc. student).

    o How to calculate correlation significance, Duncan multiple comparisons, and clustering using GenStat requested by Lina Ali (Dr. M. El-Bouhssini Ph.D. student).

    o Analysis characterization using ANOVA, LT 50, LC 50, and genetic diversity of some fungi experiments requested by Ahmad Karkukly (Dr. N. Trissi M.Sc. student).

    o Explain issue of negative value in the genotypic coefficient variance calculations requested by Kifah Gharseddin (Dr. F. Maalouf Ph.D. student).

    o How to calculate broad-sense heritability requested by Ahmad Al-Saleh (Dr. M. Nachit Ph.D. student).

    o Response reviewer statistical notes on the paper of screening lentil genotypes for resistance to BYMV requested by Aya Kanawaty (Dr. S. Kumari student).

Collaboration with NARS, ARIs

- Delivered support to all requests come from Afghanistan projects partners:

  o Analysis 10 RCBD wheat trials planted in (Jalalabad 4, Herat 5, and 1 chickpea in Mazar) using ANOVA including check data validity and integrity (e.g. outliers and typo), get multiple comparisons, and handle repeated check data in 3 approaches.

  o Revise analysis of 17 Alpha design trials (3 chickpea and 14 wheat) conducted in (3 Mazar, 3 Kabul, and 11 in Herat), and present REML add-on accuracy over simple ANOVA they used including Skype discussions and share training materials on Alpha design with Darya Khan Akbarzai.

  o Work on check Darya Khan Akbarzai data validity and integrity of GxE legume experiments in Afghanistan for possible publication.

- Delivered support to all Syrian NARS requests from either Aleppo Univ. or GCSAR staff:

  o How to calculate diversity indices, and generate RCB designs with some restriction in field layout and implementation requested by Dr. Basima Barhom (GCSAR).

  o t-Test analysis requested by Humam Yousef (Dr. M. Basmaji M.Sc. student).

  o ANOVA analysis for 2 B.Sc. projects for Dr. N. Trissi students (Beauveria mass production experiment and survey of endophytic Beauveria experiment).

  o ANOVA, t-Test, correlation and regression analysis requested by Ms. Alaa (Dr. M. Abu-Shaar M.Sc. student).

  o ANOVA analysis of infection%, yield, and lose% for BBSV and PSbMV virus B.Sc. experiments (Dr. Muhammad Al-Khalaf students).

  o Regression analysis for log% GMO vs. delta Ct requested by Dr. Fateh Al-Khatib, and analysis his M.Sc. student Ms. Aya Termaniny using ANOVA.

  o Improve Dr. B. Bayaa AJPP presentation in the 4th International Conference of the Arabic Language in Dubai 6-10 May 2015.

- ANOVA analysis for Ms. Safaa Al-Farsi Ph.D. data of RCBD factorial experiment including transformation and Tukey. She is head of seed and genetic resources research section in ministry of agriculture and fisheries, Oman.

- Processed 94 Bio-Computing online analysing requests (53 METIB, 18 METCB, 20 IBD, 1 GCCB, 1 GCIB, and 1 PA) from 4 countries (54 Afghanistan, 3 India, 2 Azerbaijan, 1 UAE, and 1 Nepal) including checking related data validity and integrity.

- Explained Bio-Computing online Augmented analysis program output to Okechukwu Emeka Chibuzor from Nigeria (Dr. F. Ogbonnaya M.Sc. student), and update version of this program to calculate BLUP for 3000 genotypes requested by Surendra Barpete from India.

Exploitation of advanced biometrical and statistical techniques (BSS-2)

- Developed and circulate GGEBiplotGUI R package training materials to generate GGE biplot using R language.

- Worked on develop draft proposal for phase II of Bio-Computing Online service using R language and Shiny server has been developed, it includes explore Shiny dashboard framework to develop professional look and feel R web applications.

- Reviewed and verified new versions of Bio-Computing Online scripts including RCBD, IBD, METCB, METIB, SPCB, SPIB, and SPUR.

- Completed the "Practical Machine Learning" course using signature track system as part of the Johns Hopkins University "Data Science" specialization certificate at Coursera.org.

- Explored R techniques and codes presented in the "Statistics and Data Analysis for Microarrays using R and Bioconductor" book.

Publications

- M. Singh and K. El-Shamaa. 2015. Chapter 16 "Experimental Designs for Precision in Phenotyping" in the "Phenomics in Crop Plants: Trends, Options and Limitations" book. ISBN: 978-81-322-2225-5. Springer.

- A. Shomar, N. Al-Hussein, K. Al-Shamaa and B. Bayaa. 2015. Effect of some Herbicides in Controlling Broomrapes (Orobanche spp.) and Major Weeds in Food Legume (Chickpea, Lentil and Faba Bean) Crops. Arab Journal of Plant Protection, 33(2): 164-176.

- A. Shomar and K. El-Shamaa. 2015. Identifying some Herbicide Resistant Grasses, Monitoring their Nature and Distribution in Southwestern part of Aleppo City. International Journal "Agriculture and Forestry", Vol. 61/4 ISSN: 0554-5579.

- M. Tamer, A. N. Trissi, M. El-Bouhssini and N. Kaake. 2015. Survey and Biological Study of Barley Stem Gall Midge Mayetiola Hordei Keiffer in Syria. Arab Journal of Plant Protection, 33(3): 259-264. (acknowledgment)

- L. Ali, M. El-Bouhssini, A. N. Trissi and K. El-Shamaa. Role of Organic Acids for Resistance to Leaf Miner, Liriomyza Cicerina Rondani. (not published yet)

- W. Dawalibi, M. El-Bouhssini, N. Kaake, S. Khoja, D. A. Landis, M. Abdulhai, A. N. Trissi, K. El-Shamaa and G. Delvare. Attractiveness of Flowering Medicinal Plants to Natural Enemies and Insect Pests in Syria. (not published yet)

- A. N. Trissi, M. El-Bouhssini, M. Skinner and B. L. Parker. Effect of Sublethal Dosages of Beauveria Bassiana on Feeding and Fecundity of Sunn Pest. International Journal of Pest Management. (acknowledgment, not published yet)

Technical support on statistical software (BSS-6)

- Supported statistical software installation and issue licenses in all requests (28 cases: 26 GenStat, 1 GenStat DE, and 1 Stata).

- Delivered quality support for users' needs in terms of guidance for Excel and statistical packages utilization in all requests (21 cases) as follow:

    o GenStat (Duncan multiple comparisons, diversity indices, correlation significance, broad-sense heritability, and hierarchical clustering).

    o R language (GGEBiplotGUI, DiGGer, and mean biplot graph).

    o Excel (Advanced sorting, PivotTable functionality, SaveDBF plug-in, F1 crosses add-in, and generate labels using mailing merge).

    o Others (Agrobase 99 and Oracle VM Virtual Box, AmScope Microscope driver, Tor browser to access CGX Google drive, and transfer big files using Dropbox).

- Followed up GenStat renewal license including purchase requests (i.e. closing 2015 and issue 2016), upgrade to the latest version (i.e. GenStat 18), update active users list, submit and follow up licenses (30 cases) including request training licenses (4 cases).

- Followed up CycDesigN renewal license for 2015.

- Worked on update BSS shared folders contents at ICARDA SharePoint Intranet.

Contribution to ICARDA's Training Activities (BSS-7)

- Delivered training sessions to 26 scientists from the NARS and academia at Aleppo University practiced on some selected advanced analysis techniques using R language at the Innovation and Technology Transfer Center, Aleppo University on June. We get a letter of thanks to ICARDA and an appreciation certificate signed by the rector of the University.

- Delivered an Alpha design training session for 9 Terbol ICARDA staff in 20 Nov.

- Processed 79 bio-computing online requests related to 3 training courses.

- Developed training materials for hierarchical clustering in GenStat and R language, and improved R introduction presentation (clustering slides, normal distribution functions, adjusted R-squared calculations, and export data in CSV).