

## Research Trainee Participation is a Bonus to Teaching Aims in the Bovine Respiratory Disease Complex Coordinated Agricultural Project

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**ABSTRACT:** Bovine respiratory disease complex (BRDC) causes morbidity and mortality. The general research objective of this coordinated agriculture project (CAP) is to use genomic approaches to identify chromosome regions and genes associated with susceptibility to BRDC. This CAP involves 7 institutions and 21 investigators. Results from six research aims are being translated to cattle industries via selective breeding tools and improved methods for disease prevention ([www.brdcomplex.org/](http://www.brdcomplex.org/)). The translational effort is also encompassed in short-course and web-based teaching efforts. Additionally, this CAP supports research trainees (i.e., graduate students, postdocs, undergraduate research interns). Within the first three years of this five year program, 68 research trainees participated. The number of research trainees illustrates a benefit of the CAP as only 14 of these students were directly funded by the grant. Therefore, the BRDC-CAP is helping solve disease challenges in cattle industries and providing research-based educational opportunities.

**Keywords:** BRD; cattle; genomics; research trainees

### Introduction

Bovine respiratory disease complex (BRDC) is a common cause of morbidity and mortality in cattle, especially young animals exposed to stress. This disease is considered a complex because of numerous pathogens, environmental and management factors (Taylor et al. (2010), Garcia et al. (2010)). The general research objective of this coordinated agricultural project (CAP) is to use genomic approaches to identify chromosomal regions and genes associated with susceptibility to BRDC. This 5 year project is funded through United States Department of Agriculture program of Agriculture and Food Research Initiative (2011-68004-30367). Research results will be translated to beef and dairy industries via selective breeding tools and methods for improving disease prevention and management ([www.brdcomplex.org/](http://www.brdcomplex.org/)). These results will also be translated to students and research trainees through parallel and integrated teaching and extension efforts.

The research aims and studies of the BRDC-CAP span from pathology and animal welfare to genome-wide association and gene expression to breeding value estimation. These aims are being executed by principle investigators and support from their staff and research trainees, which include graduate students, postdoctoral fellows, undergraduate student interns, veterinary student interns, etc.

Training of graduate students and other classes of research trainees is dual-duty of research and education programs in the animal sciences. Specifically, this is a

mentor-mentee relationship that is typically completed with writing of theses/dissertations and (or) related manuscripts to be peer-reviewed for publication (Casida (1966), Randel (2012)). This type of research-setting is also very conducive and beneficial for involving undergraduate and veterinary student interns interested in learning about livestock research.

Three years of BRDC-CAP have been completed (2011 to 2013). The teaching program is working to achieve five aims that span on-line graduate course development in animal health and genomics to intensive undergraduate study of large herd dairy management (Thomas et al. (2013)). In addition to these teaching aims, the research, teaching, and extension programs of the BRDC-CAP all involve research trainees. The objective of this report was to document research trainee participation in the BRDC-CAP for years 2011 to 2013.

### Materials and Methods

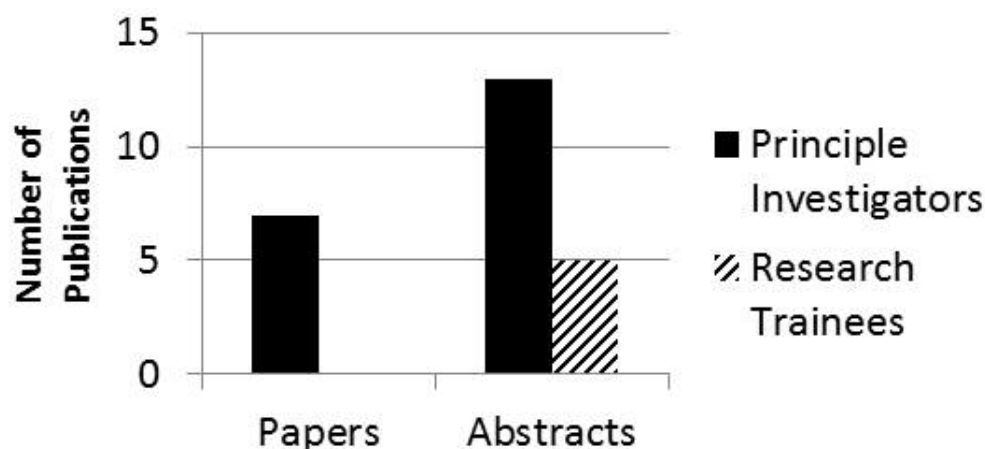
Research trainee participation information was requested from the 21 scientists (i.e., principle investigators) of the 7 research institutions involved in the BRDC-CAP. These institutions included: Colorado State University, University of California, Davis, Texas A&M University, New Mexico State University, University of Missouri, Washington State University, USDA-ARS, etc. The types of research trainees included: postdoctoral fellows, graduate students (M.S. and Ph.D.), doctor of veterinary medicine (DVM) research interns, undergraduate research interns, high school student research interns, and research technician-trainees.

The BRDC-CAP maintains a website ([www.brdcomplex.org/](http://www.brdcomplex.org/)) as to share its findings. Publications, abstracts, and presentations are posted. Thus, the formal outputs of the principle investigators and their research trainees were observed and then summarized.

### Results and Discussion

Table 1 illustrates the number of trainees, institutions, and the number of trainees participating in the BRDC-CAP after 3 years of this program. Three obvious results should be noted: 1) research activities of the CAP assists training a broad array of students with interest in genomics and disease, 2) the total number of trainees greatly exceeded the funding provided by the grant, and 3) the largest numbers of trainees were undergraduate interns.

Research internships are an effective mechanism to expose undergraduate students to research. Within the BRDC-CAP, most of the undergraduate research interns were involved in helping collect data and tissue samples



**Figure 1. Number of publications by principle investigators and research trainees participating in the bovine respiratory disease complex-coordinated agricultural project (BRDC-CAP) for 2011 to 2013.** Note: number of publications by research trainees is expected to increase in 2014 and 2015 as most of the research trainees of this CAP are currently writing theses, dissertations, 1<sup>st</sup> author peer-review manuscripts, etc. For more information visit: [www.brdcomplex.org/researchers.html](http://www.brdcomplex.org/researchers.html).

from the cattle being used to accomplish the research aims. There are many mechanisms to fund undergraduate internships, such as direct funding from a grant, funding internal to a university for internships, and (or) students garnering course-credit, typically 3 hours, within a summer or semester. Therefore, the BRDC-CAP has helped provide a venue for research activities in universities and has attracted undergraduate student participation. The universities involved in these activities are land grant universities within the United States that have animal science departments within colleges of agriculture and colleges of veterinary medicine with interest in combatting BRD. Therefore, there was a large pool of students to advertise the undergraduate student internship

opportunities.

The BRDC-CAP funds graduate students (M.S. and Ph.D.), postdoctoral research fellows, DVM-research internships, and technicians. These research trainees typically had two roles in accomplishing the research aims of this CAP. They were the vital labor for sample collection and data analyses as they simultaneously developed scientific expertise. The research aims of this CAP included:

1. Identify genomic loci associated with BRD resistance/susceptibility in beef and dairy cattle.
2. Identify the interaction of the cattle genome with the pathogens responsible for BRD.
3. Identify novel pathogens present in cattle with BRD,

**Table 1. Research trainee participation in the bovine respiratory disease complex-coordinated agricultural project (BRDC-CAP) for 2011 to 2013.**

Research trainee type	Number of Trainees	Number of Institutions <sup>1</sup>	Number funded by BRD-CAP
Postdoctoral Fellow	5	3	4
Graduate Students (M.S. and Ph.D.)	10	6	3
DVM Interns	5	2	5
Undergraduate Interns	41	3	0
High School Interns	1	1	0
Technician-trainee	6	2	2
<b>Total</b>	<b>68</b>		<b>14</b>

<sup>1</sup>Institutions and investigators in BRDC-CAP: *Texas A&M University*: James Womack, Noah Cohen, Alan Dabney, Scott Dindot, David Anderson, Christopher Seabury, Loren Skow; *University of California – Davis*: Sharif Aly, Laurel Gershwin, Terry Lehenbauer, Cassandra Tucker, Alison Van Eenennaam; *University of Missouri*: Jeremy Taylor; *Colorado State University*: Mark Enns, Milt Thomas; *New Mexico State University*: Robert Hagevoort, Tim Ross; *Washington State University*: Holly Neiberghs, Shannon Neiberghs; *USDA-ARS*: Curt Van Tassell; *University of São Paulo*: Adroaldo Zanella.

and development of diagnostic tests,

4. BRD genetic selection panel (i.e., SNP markers).
5. Develop genomic estimates of breeding values to BRD.
6. Assess how animal welfare is affected by BRD.

Accruing grant funding to support research trainees in universities has become the norm. Therefore, this CAP is providing financial resources to continue the excellent training strategies applied for many decades at land-grant research universities as described by Casida, (1966) and Randel (2012). Specifically, research training is a mentor-mentee relationship. The major professor helps the student design their first research efforts and then encourages their development to be an independent scientist. The process typically involves writing of abstracts and giving presentations at scientific meetings. The process is usually concluded with defense of an M.S. thesis or Ph.D. dissertation from which publication of the research chapters are expected in a peer-reviewed journal. Since this report is of the first 3 years of the BRDC-CAP, most of these publications are forth-coming in 2014 and 2015. The abstracts and presentations of Toaff-Rosenstein et al. (2012) and Wojtowicz et al. (2014) provide evidence of this educational-trainee process within the BRDC-CAP. Figure 1 supports the time-line described above as only abstracts from research trainees were published in 2011 to 2013.

The BRDC-CAP is supporting research training opportunities that can have direct impact on beef and dairy industries. These opportunities involved DVM research interns that will soon be working as clinicians dealing with BRD on a daily basis. The CAP also involved technician-trainees that worked and learned within the research

programs and then transitioned from a technician to employment within the livestock industries. An example of such a transition involved a trainee (Eric Chavez) that helped sample BRD case and control Holstein calves for genomics research and is now working for a bull semen distribution company.

### **Conclusions**

The BRDC-CAP is providing a plethora of trainee opportunities among its various research activities. Most importantly, the presence of this CAP within universities is accomplishing research aims while also enhancing student interests and participation in bovine genomic and health research. These research trainee opportunities are in addition to the teaching aims of the BRDC-CAP.

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