V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	6%		6%	
202	Plant Genetic Resources	6%		6%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	14%		14%	
204	Plant Product Quality and Utility (Preharvest)	6%		6%	
205	Plant Management Systems	5%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	4%		4%	
212	Pathogens and Nematodes Affecting Plants	6%		6%	
213	Weeds Affecting Plants	10%		10%	
215	Biological Control of Pests Affecting Plants	1%		1%	
216	Integrated Pest Management Systems	2%		2%	
301	Reproductive Performance of Animals	10%		10%	
302	Nutrient Utilization in Animals	10%		10%	
305	Animal Physiological Processes	10%		10%	
306	Environmental Stress in Animals	2%		2%	
307	Animal Management Systems	3%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2016	Extension		Research	
	1862	1890	1862	1890
Plan	7.5	0.0	28.9	0.0

Actual Paid	13.3	0.0	36.2	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
82104	0	475592	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
82104	0	475592	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
818729	0	2924399	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Sugarcane aphid was found for the first time in NM in 2015. In 2016 we conducted field trials in Clovis and in Artesia, NM, to evaluate suceptiblility to sugarcane aphid in cultivars that are adapted to NM conditions. One variety was identified as being particularly promising. Host plant suceptibility to glandless cotton has been evaluated to develop management tools that will allow us to commercialize this more suceptible cotton. Biological control of pests in glandless cotton has been a focus and we have determined that glandless cotton has similar levels of predation as glanded cotton. There are some differences in types of predators, but overall levels of predation are similar. Trials also were conducted in cotton to evaluate seed treatments for control of thrips and varietal resistance to fleahoppers. Recent incursions of pecan weevil into New Mexico are causing concern, as NM has been historically free of this most significant pest of pecan. We are planning research trials to support eradication efforts.

• Infrared readings and corresponding soil moisture measurements were taken for alfalfa and chile crops for one growing season. We are in the process of analyzing the data to determine if there is a strong data correlation. As with any data collection, we have the task of conducting an analysis that will help us to understand if the data is valid and reliable. In addition, work has been completed on an 8 reach canal system hydrualic model. This work has involved programming, troubleshooting, calibrating, and validating each canal reach. Programming errors were discovered and corrected and the calibration and validation process was accomplished by comparing the hydraulic model to a valid field proven open channel simulation model. Our model has been developed for this research to provide control algorithm testing capabilities that cannot be implemented on the field proven model. We will now proceed with testing control algorithms.

• Using bigtooth maples selected from provenances in New Mexico, Utah, and Texas, we evaluated physiological and growth traits of plants subjected to root zone salinity treatments. At harvest, foliar Kjeldahl nitrogen, potassium, magnesium, phosphorus, and calcium of salinity-treated plants was not

different to that of control plants. Plants from the TX provenance had the highest leaf dry weight (DW), larger stem diameter, less foliar injury, and less negative midday stem water potentials while accumulating three and two times more foliar sodium than plants from the UT and NM provenance plants, respectively. Total DW of TX plants was triple that of the other two provenances. While bigtooth maples from the three provenances tolerated salinity, those from the TX provenance show enhanced resiliency to root zone salinity. Nursery personnel wishing to choose bigtooth maple plants for managed landscapes that are challenged with salinity might look to the Texas location for their selections.

• The first dominant glandless cotton cultivar carrying the dominant glandless allele Gl2e, NuMex COT 16 GLS was approved for release as a commercial cultivar by the New Mexico Agricultural Experiment Station in 2015 and registered in Crop Science Society of America in 2016. The cultivar was grown in more than 200 acres in New Mexico and Texas. It was found to be resistant to race 4 of Fusarium wilt in California. Studies are underway to reveal its genetic basis of resistance and to transfer its resistance gene(s) to other elite Upland cottons. The cultivar was commercially grown in New Mexico and Texas, and its production will be expanded to California in 2017. About 1000 pounds of non-GMO pure Foundation Seed was produced in an isolated area in 2016. NuMex COT 15 GLS was derived from an advanced backcross progeny, followed by further testing for adventitious presence of genetically engineered biotech traits controlled by insect resistant Bt gene(s) and herbicide tolerant gene(s). This new cultivar was tested in 4 replicated field trials in New Mexico in 2013-2014 and in 11 tests across 9 states in 2014. As compared to glandless Acala GLS, NuMex COT 15 GLS yielded 50% more lint, and it produced 90% of that of glanded Acala 1517-08. Its fiber quality is classified as a medium to long staple with strong fiber strength and high uniformity, similar to other commercial medium staple cultivars, but it was inferior to both Acala cultivars. It had higher fiber elongation than most commercial cultivars tested in New Mexico. NuMex COT 15 GLS responded to thrips and Verticillium wilt similarly to Acala 1517-08 and Acala GLS. The release of NuMex GLS represents the first glandless Upland cotton cultivar carrying the introgressed dominant glandless gene Gl2e from G. barbadense with acceptable yield and fiber quality traits in the U.S.

• A promising glandless Acala cotton line NM 13P1088 was developed for a commercial release. It is a new glandless Acala cotton line carrying the double recessive glandless genes gl2gl3. Further selections were made in 2015 and 2016, and its non-GMO pure seed was increased in an isolated area in 2016 with 200 pounds ready for commercial production in New Mexico, Texas, and California in 2017. This new Acala glandless line was developed from a selection of a hybrid between an obsolete glandless Acala and glanded Acala 1517-08. NM 13P1088 was tested in New Mexico in one test in 2012, two tests in 2013, one test in 2014, and six tests in 2015, and it was also tested in more than 10 locations across the Cotton Belt in 2015. Based on results reported, it yielded 30% more lint than Acala GLS and produced 90% lint of the glanded Acala 1517-08.

• In 2016, 1000 Acala cotton lines were grown in single row plots and tested for agronomic and fiber quality traits. Two replicated field tests each with 32 lines were performed in two locations in New Mexico and a number of replicated field tests on a few selected lines were also performed across the Cotton Belt for agronomic performance. Based on results reported so far, several lines showed 20-30% higher yield than the Acala cotton check Acala 1517-08 and will be tested in 2017. Fiber quality will be tested by Cotton Incorporated using HVI.

• A multi-parent advanced generation inter-cross (MAGIC) population of 712 lines was developed from a bulked seed derived from a multi-parent random-mated RMBUP-C4 population (Reg. No. GP-961, PI

665950) of Gossypium hirsutum introgressed with G. barbadense alleles from 17 chromosome substitution lines (CSLs). The 712 lines were used to screen for salinity tolerance (Study 1) and Verticillium wilt (VW) resistance (Study 2) in the greenhouse. A total of two tests were completed for each study in 2016. Data collection included plant height, shoot and root fresh and dry weights, root to shoot dry weight ratio, and fresh to dry weight ratio. Significant genotypic differences were detected, and the most tolerant genotypes show equal to or greater shoot and root dry weights than the two parental standards, TM-1 and 3-79. For the VW resistance study, Test 1 consisted of 712 lines and Test 2 consisted of 200 lines selected from the 712 initial lines in Test 1. The plants in both tests were inoculated via pipette method at the 3rd true leaf stage with a defoliating type isolate. The lines were screened at 58 days after inoculation (DAI) in Test 1 and 51 DAI in Test 2. The total number of remaining leaves and abscised leaves were counted on a plant basis. Significant differences between the lines were observed for both the number of remaining leaves ($p < 0.033$) and abscised leaves ($p < 0.017$). Genotypic differences ($p < 0.0001$) in regards to disease severity ratings were also observed after combining the results from the two tests. The top ten most resistant genotypes and the ten most susceptible genotypes were selected based on their disease severity ratings.

• In collaboration with North Carolina State University, a collection of 360 U.S. Upland cotton germplasm was tested in four replicated tests in the greenhouse for Verticillium wilt resistance for the identification of associated markers for VW resistance using a 63K SNP Array. A disease severity rating for each plant was determined based on scale from 0-5 rating scale, where 0 for no symptoms and 5 for a full plant defoliation and/or plant death. The number of total leaves, infected leaves and defoliated leaves were also counted for each plant to calculate percentages of infected leaves and defoliated leaves. Statistical significant differences were detected for genotype, test and their interaction for all parameters expect for percentage of infected plants. Although VW resistance QTL (quantitative trait loci) detected were distributed on the entire tetraploid genome based on general linear and mixed linear models, the majority of the markers associated with VW resistance were located on chromosomes 5, 7, 16, 19, 23, and 24. Furthermore, chromosome 23 had the highest number of markers associated with VW resistance, and these markers were clustered at 10 and 30-35 Mb regions. The results will facilitate the understanding of the molecular genetic basis of VW resistance and marker-assisted selection for VW resistant cultivars in Upland cotton.

• Six replicated tests each with 32 Upland genotypes and 1 replicated test with 8 Pima cotton cultivars and lines were evaluated for resistance to Southwestern cotton rust (Puccinia cacabata) in the natural field conditions. The results showed that all current commercial Upland and Pima cotton cultivars were susceptible to rust infections. In addition, a preliminary result from three F2 populations between three resistant lines and a common susceptible cultivar detected at least one resistance gene for rust resistance. However, further tests are needed to verify the result.

• Cotton lint price is subject to fluctuations, and weak prices have led to drastic drop of cotton acreage in New Mexico. There is, therefore, an urgent need to add value to cotton production in New Mexico. New cotton cultivars that are gossypol free called "glandless cotton" can add significant value to cotton production in NM with the possibility of enhancing farmers' income. Glandless cottonseeds can be used in aquatic animal feeds and can also serve as a high protein source in the human diet without additional processing to remove gossypol. Therefore, glandless cotton production can make cotton production more profitable in New Mexico through higher value of the seeds compared to the conventional cotton seeds. Glandless cotton cultivars can increase the gross returns of cotton production in NM from about $876/acre to $1,576/acre due to much higher seed prices. This extension program has reached about 80% of cotton growers within New Mexico with the knowledge of cultural practices required to grow glandless cotton. Activities used in reaching growers include regularly scheduled newsletters, field visits and growers'

conferences. Applied research and demonstration plots evaluating different varieties of glandless cotton were set up at different Agricultural Sciences Centers and in growers' fields. The results of these trials which demonstrates the viability and profitability of glandless cotton were presented to farmers during field days and farmer visits. Through this extension program, growers in the State now have sufficient knowledge of adaptable, high yielding glandless cotton varieties and cultural practices required to grow these varieties. In 2015 season, farmers grew 100 ac of glandless cotton. This acreage increased to 200 acres of glandless cotton in 2016 season. Farmers received $800 per ton for the glandless cotton seeds in contrast to $250 per ton for the conventional cotton seeds. Farmers in New Mexico have committed to growing about 1,000 acres of glandless cotton in 2017 season.

• We conducted data mining of a new livestock GPS data set collected at 5-minute intervals on two breeds of beef cows in the Chihuahuan Desert during the growing season of 2008. Our objective was to determine seasonal changes in spatial behaviors of livestock in relation to forage greenness and livestock breed. This data set included the analysis of temporal variation in cattle behavior relative to both pasture- and animal-related factors (forage greenness and cattle breed). Our analysis categorized GPS sampling events into four seasonal forage stages - Pregreenup (12-30 Jun), Greenup (4-29 July), Peak green (14 Aug-14 Sep), and Drydown (6 -30 Nov) - and compared the breeds' behavior within each seasonal stage. Both breeds altered movement patterns in response to forage greenness. Search patterns assessed by the ratio of distance travelled to area explored (m/ha) in a day tended to become more concentrated as the forage became greener. Criollo cows, however showed a much higher seasonal adjustment of search patterns compared to Angus crossbred cows. The manuscript reporting these results has been submitted for publication. Interestingly, the ratio values derived from this data set differed considerably from those measured previously by our research group at a grassland/woodland site in central NM. Comparison of analysis results of these two data sets suggests that the development of behavior-based tools for grazing management on rangelands will possibly need to be both site- and breed-specific.

• Additional mining of data sets reported last year was conducted to determine the implications of short term variability in spatial behaviors among cows of the same herd. NMSU researchers found that cows showing more concentrated search patterns, and apparently lower daily motivation to seek new feeding sites, failed to get pregnant more frequently and were therefore culled from the herd at higher rates.

• NMSU range scientists explored the feasibility of using drones as a complementary animal monitoring platform that combines GPS with video capabilities. Ranchers in areas of the US and Mexico are beginning to rely on drones to locate and monitor cattle in large pastures. Off-the-shelf drones allow GPS positioning of animal groups and direct observation of animal activity. Hatch funds were used to leverage additional funding support to conduct preliminary controlled experiments to assess the usefulness of this tool. Our study was published in Rangeland Ecology and Management and concluded that if battery life of off-the-shelf drones was improved, this platform could be used to describe feeding behavior of cows at the level of small-to-large patches.

• Embryo survival is paramount to economic efficiency of the livestock industry as it costs producers at least $600 for every pregnancy loss that occurs, representing a serious economic drain to producers. Most losses occur during early gestation with an estimated 35%-50% fetal loss in cattle. Early gestation is critical because major developmental events occur, such as placental formation, known as placentation. Placentation includes extensive vascular development in maternal and fetal tissues to provide the developing offspring an optimal environment. Moreover, several changes occur in the maternal immune

system at the fetal-maternal interface to ensure successful pregnancy. A goal is to enhance understanding of the subcellular mechanisms regulating placentation in sheep, which serve as an ideal model for livestock. NMSU animal scientists focus on a protein called CXCR4 because it activates pivotal pathways involved in cell division, invasion, blood vessel formation (vascularization), and trafficking of immune cells to the uterus, all critical features of a successful pregnancy. Alternations in these processes can lead to pregnancy loss. We have developed a novel approach to inhibit the function of CXCR4 in vivo, allowing us to investigate the role of this protein in the animal, as opposed to in vitro studies. Specifically, we can alter the function of CXCR4 in the uterus during early gestation, when most pregnancy losses occur. These investigations have provided a greater understanding of molecular events that may drive proper placenta development. The impact of our studies has generated a firm foundation to continue studying early gestation and the role of CXCR4 in hopes of improving reproductive success and efficiency of livestock production. The overarching goal is to use the data generated to develop strategies to decrease pregnancy loss and thus the economic impact on producers. In parallel, knowledge gained will advance identification of potential biomarkers to develop preventative and therapeutic strategies for promoting placentation and successful fetal development and survival. Chemokine (C-X-C motif) ligand 12 (**CXCL12**) and its receptor, chemokine (C-X-C motif) receptor 4 (**CXCR4**), are involved in significant biological processes associated with early pregnancy including increasing trophoblast invasion and stimulating placental vascularization. To further elucidate functions of CXCL12-CXCR4 signaling during early gestation, we completed in vivo studies in which we inhibited CXCR4 signaling during early gestation in sheep using a CXCR4 antagonist, AMD3100. We hypothesized that inhibition of CXCR4 would negatively affect chemokine and angiogenic factor regulation imperative for placental development in sheep. Osmotic pumps containing PBS (control) or AMD3100 (CXCR4 antagonist) were surgically installed ipsilateral to the corpus luteum on d 12 of gestation and administered treatments directly into the uterine lumen. Maternal (caruncle and intercaruncle) and fetal membrane tissues were collected on d 23 of gestation and mRNA and protein expression were analyzed for angiogenic and growth factors. We observed several changes in critical angiogenic factors in both maternal and fetal tissues when CXCR4 function was impaired. Results from this study highlight the importance of CXCL12-CXCR4 signaling at the fetal-maternal interface. Inhibiting this axis may disrupt typical regulation of angiogenic factors needed for placental development and embryo growth. Because of the data generated we have a greater understanding of how CXCR4 functions during early pregnancy and anticipated impacts include deciphering the mechanisms of how CXCR4 regulates the expression of growth and angiogenic factors. It is known than proper angiogenic/growth factor regulation is paramount for successful pregnancy, but the upstream activators of many of these factors is not known. Our data to date indicate CXCR4 is involved in regulating angiogenic/growth factor expression and thus functions. We are excited to continue this line of research as approaches to manipulate angiogenic/growth factors during placental development may be elucidated from these studies. Because development of the placenta and tumor formation shares several similarities, a number of human studies are underway to alter CXCR4 signaling to affect tumor growth and/or cancer progression (i.e., influencing vascularization, cell migration, and cell survival). By using ideas outside the box, we hope to utilize information gleaned from human studies to apply to livestock to enhance placental development and thus fetal growth and survival.

• During this reporting period, NMSU researcher analyzed for alternations in expression of immune cell populations and cytokines known at the fetal-maternal influences pregnancy survival or loss. Impacts from our studies include a greater understanding of which immune cells are CXCR4 positive and possibly trafficked to the fetal-maternal interface. An outcome from our in vivo studies revealed that antagonizing CXCR4 signaling increased pro-inflammatory cytokines in endometrium, while anti-inflammatory cytokines increased in fetal tissue. Our results underscore the role CXCL12-CXCR4 signaling may play in regulating localized inflammation at the fetal-maternal interface, thereby contributing to pregnancy maintenance. We propose CXCL12/CXCR4 signaling plays a role in maternal-fetal communication and contributes to fetal

attachment and subsequent placentation. Further, CXCL12 promotes recruitment of select immune cells into human decidual tissues. These reports and our in vivo studies inhibiting CXCR4 suggest similar recruitment of immune cells occur in livestock. To our knowledge, this is the first report of inhibiting CXCR4 signaling in vivo at the fetal-maternal interface in livestock. These data provide new insights into the importance of this chemokine axis during attachment and placental development. Results from these studies have expanded our understanding of how CXCL12/CXCR4 signaling affects early pregnancy in livestock and generated a plethora of hypothesis drive research currently in progress.

• Two studies were conducted with one set of animals grazing dormant native forages. The second study was conducted in a Calan individual feeding system with heifers fed to mimic gains reported on dormant forage. Additionally, we grazed 8 cannulated heifers alongside animals assigned to graze dormant forage with 4 cannualted animals on each of the two planes of nutrition. Based on the supplement levels provided, we found there was no difference in nulliparious heifer performance, with AI and final pregnancy rates being similar among treatment groups. Additionally, age at puberty was similar. These results are thought to be caused, in part, by the improvement in diet selectivity of grazing heifers compared with clipped forage samples. Heifer supplement levels were determined based on NRC recommendations and clipped forage values. However, masticate samples recovered from cannulated heifers indicate the ability of these animals to select diets up to 8 percentage points greater in crude protein than that of the clipped forage samples.

• NMSU animal scientists have demonstrated an inverse relationship between nitrogen excretion and plasma concentration of branched-chain amino acids in growing steers exposed to an endotoxin challenge. Research also demonstrated that calves exposed to endotoxin had less nitrogen loss when post-ruminally infused with branched-chain amino acids. Furthermore, our feedlot research has demonstrated that ovalbumin-specific immunoglobulins increased when rumen-protected branched-chain amino acids were supplemented to cattle. Based on these results, branched-chain amino acids appear to support immune system function and decrease catabolic protein loss in stressed cattle. Our current research evaluated the bioavailability of a rumen-protected branched-chain amino acid product to support immune system function of stressed ruminants. Our research results demonstrated that ruminally-protected leucine and ruminally-protected valine were absorbed by the gastrointestinal tract of sheep, but ruminally-protected isoleucine did not increase plasma isoleucine concentrations. Our previous research demonstrated that supplementation of capsaicin does not reduce inflammation in growing cattle exposed to an endotoxin. The lack of a response to capsaicin in our research is in contrast to anti-inflammatory effects observed in nonruminant studies, possibly due to microbial degradation and low post-absorptive supply of capsaicin from the rumen of cattle. This hypothesis was supported by our subsequent research indicating that capsaicin altered volatile fatty acid profiles and increased gas production by rumen microorganisms in an in vitro batch culture fermentation system. Therefore, capsaicin may be more effective as an anti-inflammatory for ruminant animals if it is protected from microbial degradation in the rumen. Our current research has demonstrated that development of a rumen-protected capsaicin product may increase the postabsorptive supply of capsaicin in the rumen of cattle. Because previous research has demonstrated that growth of pathogenic bacteria in the gastrointestinal tract is affected by exposure to catecholamines, it is possible that rumen bacteria may respond directly to increases in mammalian stress hormones from the saliva of animals exposed to stressful conditions. Results from our research demonstrated that fermentation and nutrient digestibility are altered when rumen microorganisms are exposed to salivary cortisol and catecholamines in an in vitro system. Other feedlot research results from our group indicated correlations between blood gas parameters and calf health, which imply that blood gas analysis could potentially be used as a diagnostic tool for the early detection of bovine respiratory disease.

• Causal agents of mortality in weed seedbanks can be better understood with non-destructive assays for seed viability. Such assays enable investigations on mechanisms of seed infection by pathogenic microorganisms. NMSU weed scientists evaluated a non-destructive method for assessing viability of weed seeds with physiological dormancy. Our method, which was modified from a published study, used a resazurin reagent that was made from resazurin and yeast. In principle, changes in resazurin color caused by respiration in yeast correspond with differences in seed viability because nonviable seeds emit large amounts of solutes that are consumed by yeast. To test this, we measured color change in resazurin solutions containing single seeds that were intact, mechanically damaged or subjected to conditions that accelerated aging. Seeds were mechanically damaged by systematically slicing coats (1 incision seed-1). Accelerated aging was accomplished by storing seeds for 80 d under 60% relative humidity, 45 C; conditions created with lithium chloride solutions in air-tight containers. Weed species in this study were common lambsquarters, junglerice, Palmer amaranth and yellow foxtail. Results indicated that intact, damaged and aged seeds of common lambsquarters and Palmer amaranth could not be distinguished with resazurin solution. For junglerice and yellow foxtail, only mechanically damaged seeds caused resazurin solution to change from blue to pink after 3 hr of incubation. These results suggest that resazurin solution can be used to identify mechanically damaged Poaceae seeds. However, the resazurin solution, as evaluated in this study, cannot be used to non-destructively separate viable and nonviable weed seeds.

• A stale seedbed is a set of practices that first stimulates weed seed germination through tillage and irrigation and then eliminates subsequent seedlings with non-selective control. NMSU weed scientists developed stale seedbeds that target problematic weeds in chile pepper. Stale seedbed treatments (0, 2 or 3 stale seedbeds) were initiated during summer 2015. Each stale seedbed event consisted of the three sequential steps. First, soil in furrows was tilled to the 10-cm depth. Immediately after tillage, plots were irrigated. Fifteen days after irrigation, emerged seedlings were eliminated with cultivation. Before cultivations that eliminated emerged seedlings, weed seedlings were identified and enumerated. Results indicated that stale seedbeds reduced seedbank densities for problematic weeds in chile and reductions in weed seedbank density were similar between the 2 and 3 stale seedbed treatments. In April 2016, chile pepper was seeded into treatment plots. Before seeding, a soil-residual herbicide was applied to control early-season weeds. Weeds that emerged after crop emergence were controlled with combinations of cultivation, hand hoeing, and postemergence herbicide for grasses. Throughout the growing season, weed seedlings were periodically identified, enumerated and removed from permanent quadrats. The time required for one individual to hoe plot sections was determined for each hoeing event. Results indicated that fallow-season stale seedbeds reduced weed densities and hoeing times on specific dates in the chile production season. Across the chile season, stale seedbed-induced reductions in hoeing time were projected to save approximately $400 per acre.

• Accurate horn fly, Haematobia irritans (L.), population estimates often serve as a diagnostic tool prior to insecticidal use by implementing managerial [BS1] control options available to researchers and producers. Digital photographs taken of cattle infested with horn flies have been suggested to provide similarly accurate population estimates as compared to traditional visual assessments. Researchers compared visual and digital techniques used to estimate horn fly populations. Sixteen Angus x Hereford yearling heifers artificially infested with four levels of horn flies (Low = 0 flies; Medium = 250 flies; High = 500 flies; Extreme = 1000 flies) were evaluated. Population estimates were taken visually by experienced (VE1) and inexperienced (VE2) technicians, as well as digitally with pictures photographs taken on both lateral sides of the south facing animal. Horn flies were counted in both photographs and then combined (CDC) for full body estimates. Additionally, the highest photographed side population times two (DDC) digital counts were used for comparison. Estimations were made at 0700, 1200, and 1900 h three times

the day following infestation. A time of observation x infestation level interaction ($P < 0.01$) was detected. On average, VE1 population estimates were greater ($P < 0.01$) than any other counting method observed. Morning estimates were greater ($P < 0.05$) than those taken at noon or in the early evening regardless of counting method. Data regarding horn fly population estimates using these techniques to make managerial decisions regarding the time in which to implement insecticidal control should be done with caution. Further research regarding the standardization of these techniques to ensure more precise population estimates and the ultimate incorporation of these data methods into integrated pest management programs is warranted.

• During the 2016 year, an NMSU Extension specialist provided Master Gardener weed identification and management training programs to 316 participants. Of the surveyed attendees, 89% reported that the training changed and enriched their understanding of weed identification and management issues to either a great or a fair extent (immediately following a 3 hour training program). More specifically, surveyed participants indicated they were introduced to some new resources (91%), Learned something new about weed id and management (94%), understood more about the importance of weed identification (85%) and an integrated weed management strategy for more successful weed control (91%). Furthermore, 80% of surveyed attendees indicated a change in attitudes, ideas, and/or practices based on the information provided in the training.

• The evaluations of CEU workshops, conducted by Mr. Jason French, indicated that out of 298 attendees, a high percentage (97%) of attendees indicated that they learned something that will help them in applying pesticides, 72% of the participants believe they will change a pesticide application practice based on the information they received, and 82% of participants will change a plant management practice based on the information they received. More specifically, the attendees indicated that the presentation increased the participants' base knowledge of the material by approximately 37%.

• The evaluations of Pesticide Applicator's Trainings CEU workshops in Socorro County, conducted by Mr. John Allen, indicated that out of 32 attendees, a high percentage (81%) of attendees indicated that the information on hard water and herbicide efficiency was exceptionally helpful. Additionally, 73% of the respondents reported that they would have a change in practice by testing water hardness and applying water conditioners to their tanks to improve chemical efficacy in the field. Participants were also asked to assign a monetary value to this free workshop with an average value assigned at $90.00 per participant, or a total of $3240.00 for the workshop.

• The evaluations of the 2016 AGventure Days at the Southern New Mexico State Fair, indicated that teachers and chaperones of the approximately 1,200 school children (ranging from kindergarten to 7th grade) rated the educational value of the Amazing Bugs and Weeds presentation at a 4.6 out of 5 (1 being no educational value and 5 being of the highest educational value).

• The extension component of the Bovine Respiratory Disease (BRD) CAP has achieved a number of milestones this year including the development of a website (http://BRDComplex.org) and a dairy risk assessment tool prototype, (http://dcbsp.ucdavis.edu/t2). We have worked to develop linkages with the USDA members of regional project NC1027 (An Integrated Approach to the Control of Bovine Respiratory Disease), personnel at the National Animal Health Monitoring System (NAHMS), and have started to leverage the BRD CAP effort in an attempt to secure additional funding for projects with complementary aims. A number of presentations and publications were presented at various scientific, veterinary, and producer venues (Plant and Animal Genome, 5th BVDV Symposium, American Association of Bovine

Practitioners, Academy of Veterinary Consultants, Beef Improvement Federation, National Beef Cattlemen's Association Cattlemen's College, National Beef Cattle Evaluation Consortium webinar, county-based animal health extension meetings) to introduce the concept of the BRD CAP and discuss the value proposition of including BRD as a trait in selection indexes (see http://www.brdcomplex.org/Links/Links.html for a full listing of presentations, papers, abstracts, papers and press).

• The NMSU-Plant Diagnostic Clinic processed 467 plant samples for disorders/diseases. These samples were largely submitted by county agents and other clientele from 28 NM counties and five other states. Twelve new plant diseases in New Mexico were identified in the clinic in 2016. Identifications were uploaded to the NPDN National Repository. No National surveys were conducted in 2016. The continued demand for clinic services shows that the service is valued and needed. In addition, customer feedback survey's received in 2016 indicated that our customers are highly satisfied with the services received. They indicate that our personnel are highly responsive to their submissions and questions, the reports are very useful and they are returned in a timely manner.

• The Western Pecan Growers Association (WPGA) comprises growers from California, Arizona, New Mexico, and Texas. Its annual conference is attended by pecan producers from each of those four states, as well as southeastern US and northern Mexico. Since 1966, this conference has offered pecan producers, especially those in arid production areas, the best opportunity of its kind for attending presentations by researchers and other experts in pecan production. Additionally, this conference allows growers to network with other growers and industry representatives from around the world .More than 500 attendees were at the 2016 WPGA Conference. They mostly came from southern and central New Mexico (Doña Ana, Luna, Otero, Chaves, Eddy, Lea, Sierra, and Valencia counties), west Texas (El Paso, Culberson, Pecos, and Gaines counties), southern Arizona (Cochise, Pima, Pinal, Santa Cruz, and Maricopa counties), and the California Central Valley (Tulare, Stanislaus, Butte, Colusa, and Tehama counties). Some also came from the southeast and south central US (mainly Georgia and Texas) and northern Mexico (mainly Chihuahua and Sonora states). On one occasion, on the second day of the conference, I counted about 200 people in the educational program (there were many, many additional conference attendees out with the exhibits). A survey was administered at the end of the WPGA conference. Sixty-six percent of survey respondents indicated that they will incorporate information from the program into their orchard management in the coming year. This is a similar percentage to what was seen last year (68%), but is definitely not as good as it was in 2014, when 85% of respondents said they got information that they would incorporate into their orchard management. In the 2016 survey, 94 percent of respondents indicated that they plan to attend the 2017 WPGA conference and 93% indicated that they will recommend this conference to other pecan growers.

• Soil health issues have become increasingly prominent in New Mexico, with many farmlands already degraded, erosion by wind and water are common in many agricultural systems. Yearly off-site erosion costs in New Mexico, including health and property damage, are estimated to be nearly $500 million. These losses exclude those from reduced yields of crops and increased cost of inputs due to land degradation. In 2015, the value for crop production in New Mexico was about $702 million, and continued sustainability of the crop production industry in the State is dependent on maintaining and improving soil health of agricultural fields. Therefore, extension combined with applied research program was developed, to address soil heath issues in cropping systems of New Mexico. This program reached several crop producing Counties (>15) with educational information related to building soil health and preventing environmental degradation such as soil erosion. Extension publications were developed and several presentations given to help agricultural producers and other land users in New Mexico reduce the degradation on their farmlands. Three major practices were advocated for reduction and/or reversing soil degradation on farmlands. They were cover cropping, adding organic amendments and reduced tillage. Over 80% of growers that attended three different events including a major conference in New Mexico,

to improve soil health and prevent soil degradation. About 20% of land managers have started to practice cover cropping and/or adding organic amendments to their soils.

• Alfalfa Weevil parasitoids were released in 4 counties in NM. Alfalfa weevil continues to be a very serious pest in most of New Mexico. In 2015-2016 it caused up to 100% loss of first cuttings in some areas with the highest losses in the upper Rio Grande Valley.

• Vegetable production in New Mexico is being squeezed by higher production costs (labor, chemicals, fuel, etc.), drought, and increasing disease pressure. Acreage for chile peppers, one of the key vegetable crops in the state, has dropped from approximately 16,300 acres in 2004 to less than 10,00 acres in 2011. The erosion of chile acreage in the state is a serious threat to large-scale commercial vegetable processing. Simultaneously, there's been a large increase in the number of farmers markets and other direct marketing of produce in the state. In order to fill this increasing demand for locally grown vegetables, small- and mid-sized farms require support. Several mechanical harvest tests were completed, including repeats of the 2015 green chile mechanical harvest variety trial and the investigation into mechanical harvest efficiency of green chile plants at three different plant spacings. In addition, green chile breeding lines that have been in development for many years were tested with the ETGAR harvester for the first time in 2016.

• Animal agriculture contributes 74% of the 4 billion dollar revenue generated by agriculture in New Mexico. Therefore, sustaining or improving the productivity of animal agriculture through extension education in New Mexico is vital. The purpose of the Tucumcari Bull Test is to offer a location where pure bred cattle producers and collect data and market their bulls. The test has been in place for over 50 years. The test and sale is well known throughout the state as a source for other producers to buy quality genetics. Most the producers who use this test station are native to New Mexico. As a result of this new found energy within the group, the 2015/2016 maximized the capacity of the test; feeding 147 bulls during the 120 day test. Ninety-eight of 114 bulls sold at an average price of $4200. The price was lower than the previous year, but reflective of the current market. This was, however, an increase of 78% in not only bull numbers in the sale, but revenue for the participating producers from 2015. With some pen adjustments, the 2016/2017 bull test has once again expanded the numbers of bulls on test to 155. Of the 155 bulls on test, approximately 125 will make the sale. These numbers reflect another 10% increase over the 2015/2016 test.

• The New Mexico Rural Veterinary Practice Relief Program is a portion of my major programming that is very important for New Mexico. The Extension Veterinarian formed this program to respond to the need for rural veterinary practitioners in New Mexico, visualizing a program where New Mexicans would be involved in selecting New Mexico native students to attend a College of Veterinary Medicine. We secured agreements with Kansas State University College of Veterinary Medicine to accept New Mexico students selected by our New Mexico selection committee. We have worked with legislators and this year was able to secure funding legislation for the maintenance of this program. The legislation was not successful in the end, but passed through all committees before being line item vetoed on the last day. The Governor is supportive of this program and will probably fund this program when the New Mexico economic picture has improved. There is wide ranging legislative and industry support for this program. We have selected seven students to date to attend the KSUCVM. Only one student had been selected to attend another College of Veterinary Medicine, so for six of these students this was their only opportunity to attend veterinary school. A major change developed this year at the Veterinary Medical Advisory Committee of the Western Interstate Commission on Higher Education, WICHE, at their annual meeting. We presented a scenario where the states would have input into the selection of students from their states. CSU adopted the suggestion and NM will be involved in the selection of WICHE students that apply to the CSU College of Veterinary Medicine. The other WICHE schools are considering this proposal.

• Trichomoniasis became a New Mexico reportable disease in 2005 due to the diagnosis of the disease in a large area of north- central New Mexico. When the disease was listed as reportable, the incidence of

disease among bulls tested was 6.5% positive for the disease. With further investigation, the disease was found to be present over a large portion of New Mexico. State animal health officials felt it necessary to begin a disease control program to limit the spread of the disease. It became apparent that producer education would be the cornerstone of a Trichomoniasis control program. The NMSU Extension Veterinarian was asked by the NM State Veterinarian to lead the development of a Trichomoniasis Control program for New Mexico. The program was developed and instituted in 2006. The program is centered on producer education, and educational programs have been held all over New Mexico. As producers become more aware of the disease, more testing and control measures have been instituted, reducing the disease incidence in the state.

2. Brief description of the target audience

The target audience includes: ranchers, feedlot operators, dairy producers. small/medium/large-scale agricultural operations, business, associations, cooperatives, consulting firms and collectives that might or might not be defined as a farm under the USDA economic return criteria, but are land owners, managers, consultants, or students who wish to improve agricultural production and efficiency. Other audience participants include Extension agents, other agricultural specialists, pesticide applicators, Master Gardeners and garden clubs, youth (4H, Future Farmers of America and other groups) and the general public.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2016	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year:	2016
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2016	Extension	Research	Total
Actual	9	98	107

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- The specific output measures will vary according to the specific project being monitored. The development of research procedures and technology, training of students, publishing research papers, and disseminating research results via educational workshops, conferences, and Extension media are important outputs for the various projects falling under this planned program.

Year	Actual
2016	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	# of trained professionals
2	# of improved animal varieties
3	# of research publications
4	# of methods, technology, and animal varieties adopted by public and private sectors
5	# Extension publications

Outcome #1

1. Outcome Measures

# of trained professionals

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	29

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The agricultural disciplines need to replace retiring professionals.

What has been done
Students have been trained.

Results
New professionals have been graduated.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems

Outcome #2

1. Outcome Measures

# of improved animal varieties

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

# of research publications

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	98

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The research results published in peer-reviewed journals matter to other professionals in the disciplines, by advancing the knowledge in the discipline.

What has been done
Knowledge has been generated and reported.

Results
Professionals have a deeper knowledge base from which to draw.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
305	Animal Physiological Processes
306	Environmental Stress in Animals
307	Animal Management Systems

Outcome #4

1. Outcome Measures

# of methods, technology, and animal varieties adopted by public and private sectors

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Extension publications

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2016	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Extension professionals rely on the information in Extension publications.

What has been done
Knowledge has been developed and disseminated.

Results
Extension professionals have recommendations and knowledge to disseminate.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
307	Animal Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Budget cuts have affected the number of faculty and staff available to generate and disseminate knowledge.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}