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## ARD News April 1998

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# ARD

## Agricultural Research Division News

Office of the Dean, 207 Ag Hall, P.O. Box 830704, Lincoln, NE 68583-0704, Phone (402) 472-2045, FAX (402) 472-9071

April 1998

Volume 32, Number 5

### Comments from the Dean

Dear Colleagues:

This is the time of year that IANR administrators work with members of Congress on federal appropriations for the upcoming fiscal year that begins Oct. 1, 1998. This year we are confronted with a President's budget proposal that calls for a 9 percent decrease in Hatch Act funds and a 4 percent decrease in Smith-Lever funds. The President's budget for FY 1999 is described more fully elsewhere in this issue of *ARD News*. The proposed decrease in federal formula funds totals \$435,000 for ARD and CED. This translates into a decrease of about 13 faculty positions should the President's proposal prevail with Congress.

We are particularly concerned about the proposed decrease in federal formula funds when an analysis shows that Hatch and Smith-Lever funds have a 16 percent decrease from 1988 to 1998 when expressed in 1992 dollars (see figure at right). This decrease is in contrast to large increases for NASA, NIH, USEPA, and NSF during this time frame.

Apparently, USDA has not been as effective as other research entities in convincing Congress that additional resources are needed to maintain high quality programs. This is particularly alarming when viewed in the context of congressional intent to increase the NIH and NSF funding by 50 percent over the next few years.

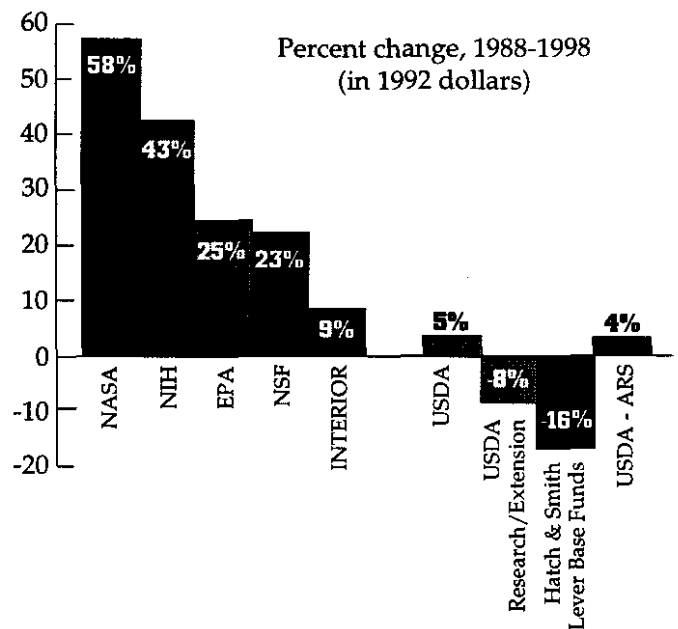
Unfortunately, USDA research is never included in the discussion when members of Congress discuss the importance of research and development in shaping the future of the U.S. We have a major task ahead of us to convince the decision makers that investments in research are needed if agriculture is to feed the world's population in the 21st century.

Vice Chancellor Omtvedt, Dean Bolen and I are working diligently with the Nebraska congressional

delegation to maintain appropriate levels of Hatch and Smith-Lever funding. We are hopeful that Congress will not accept the President's proposal and will instead increase formula fund appropriations by 5.8 percent as recommended by NASULGC.

Given the issue of federal formula funding and the uncertainty of the UNL reallocation process, the program deans are taking a conservative approach to releasing faculty positions for recruitment. It is our desire to avoid aborting searches after once initiated, and we will not permit support staff to again bear the brunt of budget reductions or reallocation "taxes." Therefore, we are asking for your understanding if we do not release faculty positions in an expeditious manner.

*Darrell W. Nelson  
Dean and Director*



Federal Agencies Research and Development Funding



It is the policy of the University of Nebraska-Lincoln not to discriminate on the basis of gender, age, disability, race, color, religion, marital status, veteran's status, national or ethnic origin or sexual orientation.



## FY 1999 USDA-CSREES Budget

Congress is currently holding hearings on the FY 1999 USDA budget. The President's budget proposal calls for a 4.5 percent reduction in total CSREES research appropriations (see following table). Most of the reduction is contained in a 9 percent decrease in Hatch Act funds, 3 percent reduction in McIntire-Stennis funds, and elimination of state specific grants.

If implemented, these decreases would reduce the ARD budget by about \$315,000. The President is recommending a 34 percent increase in funding for the National Research Initiative and significant increases in funding for food safety, IPM/Biological Control, pest management alternatives, clearance of pesticides for minor crops, and sustainable agriculture.

The Board on Agriculture of the National Association of State Universities and Land Grant Colleges (NASULGC) also has developed a recommended budget for FY 1999 (see following table). The NASULGC budget recommendation calls for a 5.8 percent increase in all formula funds and elimination of state-specific special grants. It accepts most of the President's proposed funding increases in the NRI and Special Research Grants. NASULGC also is requesting the establishment of new programs in soil quality, agriculture genomics and the small farm initiative. IANR administrators are working with the Nebraska congressional delegation on behalf of the NASULGC budget recommendations.

### Cooperative State Research, Education, and Extension Service Budget

Research Programs	FY 1998 Appropriation Act	FY 1999 President's Budget	FY 1999 NASULGC Recommend
----- Thousands of \$ -----			
<b>Base Programs:</b>			
Hatch Act	168,734	153,762	178,352
McIntire-Stennis			
Cooperative Forestry	20,497	19,882	21,665
Evans-Allen Program	27,735	27,735	29,316
Animal Health & Disease, Section 1433	4,775	4,775	5,047
<b>Subtotal:</b>	<b>221,741</b>	<b>206,064</b>	<b>234,380</b>
<b>Special Research Grants:</b>			
Soil Quality	0	0	1,500
Critical Issues	200	200	200
Expert IPM Decision Support System	177	260	260
Food Safety	2,000	5,000	4,000
Global Change, UV-B Monitoring	1,000	1,567	1,567
Integrated Pest Management & Biological Control	2,731	8,000	8,000
Minor Crop Pest Management, IR4	8,990	10,711	10,711
Minor Use Animal Drugs	550	550	550
National Biological Impact Assessment Program	254	254	0
Pesticide Impact Assessment	1,327	1,327	1,327
Pest Management Alternatives	1,623	4,200	4,200
Rural Development Centers	423	423	423

Research Programs	FY 1998 Appropriation Act	FY 1999 President's Budget	FY 1999 NASULGC Recommend
<b>Special Grants (continued)</b>			
United States/Israel — Binational Agriculture Research & Development (BARD)	500	2,000	0
Water Quality	2,461	2,757	2,757
Other (state specific grants)	43,867	0	0
Tropical/Subtropical Agriculture	2,724	0	2,724
<b>Subtotal:</b>	<b>66,103</b>	<b>37,249</b>	<b>39,219</b>
<b>National Research Initiative Competitive Grants:</b>			
Agricultural Genomics	0	0	10,000
Natural Resources & the Environment	17,500	27,000	22,000
Nutrition, Food Safety & Health	8,000	11,000	10,000
Plants	37,000	47,000	44,500
Animals	24,000	29,500	28,000
Markets, Trade, & Rural Development	3,900	6,500	6,500
Processing for Adding Value or Developing New Products	6,800	9,000	9,000
<b>Subtotal:</b>	<b>97,200</b>	<b>130,000</b>	<b>130,000</b>
<b>Other Research</b>			
Rangeland	0	0	475
Critical Agricultural Materials	550	0	0
Aquaculture Centers	4,000	3,880	4,000
Sustainable Agriculture Programs	8,000	10,000	10,000
Supplemental & Alternative Crops	650	0	650
Federal Administration (Direct Appropriation)	11,226	3,896	3,896
Small Farm Initiative	0	0	4,000
<b>Subtotal:</b>	<b>24,426</b>	<b>17,776</b>	<b>23,021</b>
<b>Total for Research</b>	<b>\$409,470</b>	<b>\$391,089</b>	<b>\$425,620</b>

## Grant and Contract Income Obtained by ARD Units During the Last Four Calendar Years

Following is a table listing the grant and contract income obtained by ARD units during the last four calendar years, expressed on a \$/research FTE/year basis. Also listed is the unit average for the last four years. Grants obtained by interdisciplinary centers are not listed. Therefore, the listing is not a completely accurate representation of the grant and contract funds available to faculty in a given unit, since some faculty obtain significant research funding from team efforts coordinated by centers. Units not listed are either service-oriented or represent disciplines with very limited opportunities for grant funding.

**Research Grant and Contract Income During  
the Last Four Calendar Years Expressed in Dollars  
Per Research FTE Basis**

Unit	1994	1995	1996	1997	Average 1994-97
Agricultural Economics	18,869	3,955	3,111	2,639	7,144
Agricultural					
Meteorology	430,606	617,943	419,140	417,141	471,208
Agronomy	66,960	91,364	102,631	63,403	81,090
Animal Science	62,363	42,776	77,981	79,949	65,767
Biochemistry	185,078	222,334	184,299	226,515	204,557
Biological Systems					
Engineering	103,544	50,519	58,619	54,266	66,737
Biometry	1,646	16,086	-0-	-0-	4,433
Entomology	107,809	57,578	131,234	147,483	111,026
Family & Consumer Science	22,695	21,293	-0-	-0-	10,997
Food Science & Technology	170,152	208,439	200,032	362,253	235,219
Forestry, Fisheries, & Wildlife	311,368	284,425	167,937	184,074	236,951
Horticulture	34,891	65,420	104,240	63,841	67,098
Northeast R&E Center	48,443	66,883	76,140	80,861	68,082
Nutritional Science & Dietetics	25,235	12,992	3,226	7,722	12,294
Panhandle R&E Center	83,445	92,581	142,273	97,986	104,071
Plant Pathology	186,034	157,817	138,274	86,465	142,148
South Central R&E Center	29,409	88,292	64,918	85,862	67,120
Textiles, Clothing & Design	-0-	-0-	13,075	18,174	7,812
Veterinary & Biomedical Sciences	117,863	167,402	168,937	173,260	156,866
West Central R&E Center	25,179	22,484	29,177	37,342	28,546
<b>Average</b>	<b>101,579</b>	<b>114,529</b>	<b>104,231</b>	<b>109,461</b>	<b>107,450</b>

The overall average of unit grant and contract income for 1997 increased about 5 percent from 1996 to \$109,461/research FTE. This level is about 4 percent lower than the record average achieved in 1995.

We were pleased to see that during 1997 several units increased their average grant and contract income from 1996 levels. Agricultural Meteorology; Biochemistry; Entomology; Food Science and Technology; Forestry, Fisheries and Wildlife; and Veterinary and Biomedical Sciences are to be commended for sustaining high levels of grant and contract income. We encourage faculty to continue submitting grant proposals to federal competitive grant programs as well as to private industry and other organizations.

**Average Unit Outputs Exceed ARD Goals Again in FY 1997**

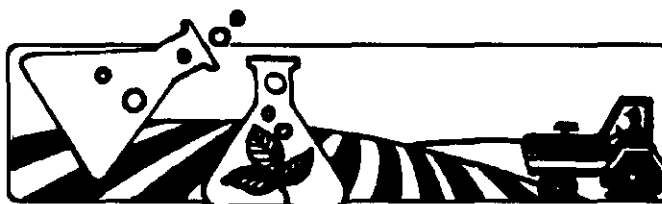
We are pleased to report that during FY 1997 the average outputs of ARD units again exceeded the performance goals established by the ARD Advisory Council. This represents a tremendous record of sustained accomplishment, and all faculty should feel good about their role in helping us achieve these goals. The ARD goals and the unit averages for FY 1997 are shown below:

Indicator	ARD Average	ARD Goal	% Goal	No. Units Exceeding Goal
Appr. \$/FTE	181,847	150,000	121	16
Grant \$/FTE	115,902	100,000	116	8
Grant \$/Appr. \$	0.612	0.667	92	7
Tot. Resources, \$	296,702	250,000	119	12
Ref. Pubs./FTE	3.56	3.00	119	11
Theses/FTE	1.45	1.00	145	11

The average outputs from ARD units increased significantly during the past five years. Relative increases since FY 1993 are: appropriated \$/FTE, 18 percent; grant \$/FTE, 62 percent; total \$/FTE, 32 percent; refereed publications/FTE, 34 percent; and theses-dissertations/FTE, 42 percent. Grant proposals/FTE have declined by 15 percent. Average outputs during the past five years are given below:

Indicator	ARD Average for 20 units				
	FY 93	FY 94	FY 95	FY 96	FY 97
Appr. \$/FTE	154,165	156,120	158,572	166,925	181,847
Grant \$/FTE	71,693	108,884	104,152	167,960	115,902
Grant \$/Appr.\$	0.523	0.728	0.664	0.985	0.612
Tot. Resources, \$	224,972	265,002	262,723	334,884	296,702
Ref. Pubs./FTE	2.66	3.37	3.47	3.85	3.56
Theses/FTE	1.02	0.97	1.43	1.17	1.45
Grant Prop./FTE	8.08	7.55	7.54	7.48	6.94

It is our challenge to remain at or above the FY 1997 levels of accomplishments. Continuation of these output and grant funding levels will ensure that our programs are viable and well respected. We also should keep in mind that achieving quantitative goals does not ensure that our programs are having desired impact. Each of us must work to have the knowledge and technology developed in our programs used by our peers and clientele.



**Grants and Contracts  
Received  
February and March, 1998**

<b>Agricultural Economics</b>	
Miscellaneous grants under \$10,000 each	\$ 200
<b>Agricultural Meteorology</b>	
Shashi Verma and Blaine Blad — DOE/NIGEC	1,368,871
<b>Agronomy</b>	
James Specht — North Carolina State	74,215
Miscellaneous grants under \$10,000 each	42,717
<b>Animal Science</b>	
Terry Klopfenstein — U.S. Poultry and Egg Association	55,000
Mark Morrison — USDA/CSREES	190,000
Miscellaneous grants under \$10,000 each	34,460

<b>Biochemistry</b>	
Stephen Ragsdale — NIH	29,900
<b>Biological Systems Engineering</b>	
Richard Koelsch — USDA/NRCS	29,660
Miscellaneous grants under \$10,000 each	5,349
<b>Center for Rural Revitalization</b>	
Sam Cordes — Nebraska Department of Environmental Quality	40,000
<b>Entomology</b>	
Miscellaneous grants under 10,000 each	24,000
<b>Food Science and Technology</b>	
Mike Meagher — Peppen Corporation	203,452
Steve Taylor — Nebraska Department of Economic Development	25,000
Miscellaneous grants under \$10,000 each	28,140
<b>Horticulture</b>	
Dermot Coyne — Michigan State University	255,300
Miscellaneous grants under \$10,000 each	15,000
<b>Industrial Agricultural Products Center</b>	
Milford Hanna — National Corn Growers	29,940
<b>Northeast Research and Extension Center</b>	
Miscellaneous grants under \$10,000 each	13,904
<b>Panhandle Research and Extension Center</b>	
Miscellaneous grants under \$10,000 each	41,600
<b>School of Natural Resources</b>	
Kyle Hoagland and Blair Siegfried — USGS	50,006
Shripat Kamble — Ohio State University	22,275
Roy Spalding — Nebraska Department of Agriculture	20,000
Elizabeth Walter-Shea and Shashi Verma — NASA	505,000
Albert Weiss — NSF	350,000
Miscellaneous grants under \$10,000 each	5,000
<b>South Central Research and Extension Center</b>	
Miscellaneous grants under \$10,000 each	4,500
<b>Veterinary and Biomedical Sciences</b>	
Jeff Cirillo — NIH	75,097
Ruben Donis — USDA/CSREES	180,000
Gerald Duhamel — Fort Dodge Animal Health	54,000
Clayton Kelling — Pfizer, Inc.	28,600
Marjorie Lou — NIH	298,229
Miscellaneous grants under \$10,000 each	2,153
<b>West Central Research and Extension Center</b>	
Miscellaneous grants under \$10,000 each	7,250
<b>Grand Total</b>	<b>\$ 4,108,818</b>

## Proposals Submitted for Federal Grants

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The following is a listing of proposals that were submitted after February 1998 by faculty for federal grant programs. While not all grants will be funded, we are appreciative of the faculty member's effort in submitting proposals to the various agencies.

**Richard K. Koelsch** — USDA/NRCS — NRCS/UNL Phosphorus Management Study in Saunders County, Nebraska — \$29,600

**James P. Stack** — USDA/CSREES — Epidemiology and Life History of *Claviceps africana* in the Great Plains — \$35,000

**Raul G. Barletta** — USDA/NRICGP — Identification of *Mycobacterium avium paratuberculosis* Virulence Determinants — \$361,291

**Kyle Hoagland and Istvan Bogardi** — USEPA — Detection and Prediction of Regional Ecological Impacts of Climate Changes on Midwestern Lakes and Reservoirs — \$422,178

**Al Weiss, Timothy Arkebauer, P. Stephen Baenziger, Drew J. Lyon, S. Madhavan, David R. Shelton and Jerry W. Maranville** — U. S. EPA — Integrating Multilevel Indicators of Global Climate Change in the Great Plains Wheat Ecosystem — \$643,510

**Terry L. Mader, John A. Nienaber and Anne M. Parkhurst** — USDA/NRICGP — Dynamic Responses of Feedlot Cattle Exposed to Heat Stress — \$427,350

**Terry Klopfenstein, Richard T. Clark and Walter Schacht** — USDA/NRICGP — Enhancing Rural Communities and the Environment Through Value-Added Beef Systems — \$499,376

**James R. Brandle, Qinfeng Guo and Ron J. Johnson** — USDA/NRICGP — Tree-based Buffers: Ecological Implications in Agricultural-dominated Landscapes under Shifting Climate Scenarios — \$227,502

**Gautam Sarath and Robert V. Klucas** — USDA/NRICGP — Soybean Root Nodule 5'-nucleotidase and 5'-nucleosidase — \$188,791

**David S. Jackson and Deepak Sahai** — USEPA/NSF — Development of a Novel Industrial Corn Nixtamalization Process for Minimizing Source Waste, Fresh Water Use and Effluent Generation — \$211,748

**Albert Weiss** — USEPA — Integrating Multilevel Indicators of Global Climate Change in the Great Plains Wheat Ecosystem — \$643,510

**Kyle D. Hoagland** — USEPA — Detection and Prediction of Regional Ecological Impacts of Climate Change on Midwestern Lakes and Reservoirs — \$422,178

**Robert Klucas and Gautam Sarath** — USDA/NRICGP — Soybean Root Nodule Ferric Leghemoglobin Reductases — \$130,430

**James R. Brandle, Qinfeng Guo and Ron Johnson** — NASA/NSF/DOE/USDA/NOAA Joint Program on Terrestrial Ecology and Global Change TECO — Modeling the Effects of Climate Change on Biodiversity in Agricultural Landscapes in the Great Plains — \$281,737

**Marjorie F. Lou** — NIH — Protein-Thiol Mixed Disulfides in Cataractogenesis — \$2,088,571

**Joan Poor** — USEPA/NSF — A Model to Examine the Inter-Relationship Between Air Quality and Community Level Socio-Economic Characteristics to Assist in Permitting and Pollution Prevention Efforts — \$201,696

**Joan Poor** — USEPA — A Model to Examine the Inter-Relationship Between Point Source Emissions and Community Level Socio-Economic Characteristics to Assist in Environmental Justice and Pollution Prevention Efforts — \$19,997

**Jim VanEtten, T. Jack Morris, Paul Staswick, Paul Blum and Stephen Baenziger** — USDA/North Central Biotechnology Initiative — \$200,000

# 1997 Graduate Student Survey

Graduate student data represents enrolled and non-enrolled students for the fall 1997 semester. Only non-enrolled students actively pursuing a graduate degree within the time limit for granting degrees (eight years for a Ph.D. and six years for an M.S.) are considered. The graduate program in the Agricultural Research Division (College of Agricultural Sciences and the College of Human Resources and Family Sciences) decreased 8.3 percent from the fall semester 1996 to the fall semester 1997. Forty-three percent are in Ph. D. programs. Forty-one percent of our graduate students are female. Sixty-five percent of the graduate students in CASNR majors are supported by assistantships (state appropriated GRA's and GTA's; grants; fellowships; and international agency or foreign country support). Forty-two percent of the students in the College of Human Resources and Family Sciences are supported. Nine CHRFS students receive GTA's through Academic Affairs (AA).

Major/Unit	MS				PhD				Total		
	GRA	GTA	Other <sup>1</sup>	Self	GRA	GTA	Other	Self	95	96	97
<b>College of Agricultural Sciences and Natural Resources</b>											
Agricultural Economics	5	0	2	4	4	0	10	10	38	35	35
Agricultural Leadership, Education and Communication <sup>2</sup>	1	1	3	21	0	2	0	2	12	33	30
Agricultural Meteorology <sup>3</sup>	1	0	0	2	1	0	6	2	14	12	12
Agronomy	5	1	23	40	4	0	42	19	143	138	134
Animal Science	22	0	23	9	8	0	24	13	79	92	99
Biochemistry	1	1	4	0	6	3	7	0	25	20	22
Biological Systems Engineering <sup>4</sup>	11	0	6	10	10	0	6	3	40	41	46
Biometry	2	8	2	7	—	—	—	—	14	21	19
Entomology	1	0	8	3	4	1	16	0	25	27	33
Food Science and Technology	2	0	12	7	8	0	7	8	41	65	44
Forestry, Fisheries and Wildlife <sup>5</sup>	1	2	7	13	—	—	—	—	46	23	23
Horticulture <sup>5</sup>	0	1	4	7	—	—	—	—	16	10	12
Horticulture and Forestry	—	—	—	—	5	0	5	4	—	19	14
Mechanized Systems Management	1	1	0	5	—	—	—	—	8	8	7
Plant Pathology <sup>6</sup>	0	0	1	4	6	0	2	2	16	16	15
Veterinary and Biomedical Sciences <sup>7</sup>	3	0	4	4	6	0	13	1	43	38	31
<b>Total</b>	<b>56</b>	<b>15</b>	<b>99</b>	<b>136</b>	<b>62</b>	<b>6</b>	<b>138</b>	<b>64</b>	<b>560</b>	<b>598</b>	<b>576</b>
<b>College of Human Resources and Family Sciences</b>											
Family and Consumer Sciences	2	6AA	2	16	—	—	—	—	31	25	26
Nutritional Science and Dietetics	4	9	7	12	—	—	—	—	53	42	32
Textiles, Clothing and Design	—MS	2	0	1	0	—	—	—	5	6	3
	—MA	0	1	0	3	—	—	—	4	2	4
Interdepartmental Nutrition	0	2	1	0	1	0	4	2	9	11	10
Interdepartment Human Resources and Family Sciences	0	0	0	25	4	3AA	2	14	65	78	48
<b>Total</b>	<b>8</b>	<b>18</b>	<b>11</b>	<b>56</b>	<b>5</b>	<b>3</b>	<b>6</b>	<b>16</b>	<b>167</b>	<b>164</b>	<b>123</b>
<b>Grand Total</b>	<b>64</b>	<b>33</b>	<b>110</b>	<b>192</b>	<b>67</b>	<b>9</b>	<b>144</b>	<b>80</b>	<b>727</b>	<b>762</b>	<b>699</b>

- (1) = Other — grant support, international agency or foreign country support, fellowships
- (2) = Ph.D. students obtain degrees in Teachers College
- (3) = Graduate degrees are obtained from other departments
- (4) = Engineering degrees are offered through the College of Engineering and Technology
- (5) = The Ph.D. program is in the Horticulture and Forestry major
- (6) = Degrees obtained through the School of Biological Sciences
- (7) = Ph.D. degrees are offered through UNMC

## Diane says

The greatest labor saving device today is tomorrow.

## New or Revised Projects

The following station projects were approved recently by the USDA Current Research Information System:

### NEB-13-137 (Animal Science) Recombinant Bovine Gonadotropins

*Investigator(s):* H. Edward Grotjan and James E. Kinder  
*Status:* New Competitive Grant effective Sept. 15, 1997

### NEB-23-002 (Biometry) Stress Factors of Farm Animals and Their Effects on Performance

*Investigator:* Anne M. Parkhurst  
*Status:* New Hatch project that contributes to regional project W-173 effective Oct. 1, 1996

### NEB-48-019 (South Central Research and Extension Center) Managing Weeds and Herbicides for Profitable Crop Production and Reduced Environmental Risks

*Investigator:* Fred W. Roeth  
*Status:* Revised Hatch project effective Jan. 6, 1998

### NEB-91-042 (Nutritional Science and Dietetics) Nutrient Bioavailability: A Key to Human Nutrition

*Investigator:* Judy A. Driskell  
*Status:* Revised Hatch project that contributes to W-143 effective Oct. 1, 1997

## Training Required for All Persons Working with Lab Animals

The USDA is requiring that UNL document the training and qualifications of the faculty, graduate students, undergraduate students and staff who will be working on projects involving lab animals. Each person working on a project must complete a form indicating the training and experience that the individual has with lab animals. Forms are available from Cindy Evans, director of Veterinary Services.

The type of documentation that is needed may include the individual's academic degrees, expertise of the person with the animal species to be used in the study, and the training provided by the principal investigator at the beginning of the project. If additional training is required, please contact Cindy Evans.

## Licensing Income and Patents in FY 1996

An article in a recent issue of the *Chronicle of Higher Education* reports that UNL ranks 53rd among universities in the amount of royalties received from patented intellectual property. During FY 1996, UNL received about \$581,000 in royalty income from 15 active licensing agreements. In FY 1996, UNL received 15 patents and assisted a faculty member in starting one company.

Data for FY 1997 should indicate a much higher level of royalty income.

IANR scientists have been major contributors to UNL's success in increasing patent and licensing activity. We encourage all faculty to carefully consider if their technology could be proprietary and have commercialization potential before public disclosure of the information. If you have questions about the potential for patenting your intellectual property, please contact Dale Vanderholm for information and advice.

## 1997 Cash Receipts from Crops and Livestock

Nebraska continues as the fourth ranked state in total value of cash receipts from crop and livestock sales behind California, Texas and Iowa. We have been fourth ranked behind these states for a decade. Listed below are the cash receipts from crop and livestock marketing during 1997 for selected states:

State	Livestock	Crops	Total
----- billions of dollars -----			
California	6.30	17.49	23.79
Texas	8.56	5.23	13.79
Iowa	5.32	6.95	12.27
Nebraska	5.45	4.06	9.51
Kansas	5.03	3.71	8.73
Minnesota	3.97	4.29	8.26

## Publication of Scientific Articles in World Journals\*

Listed below are data regarding the total number of scientific articles published in various agricultural-related fields in 1981 and 1993 as reported by NSF.

NSF Field	Subfield	1981	1993
Medicine	Veterinary medicine	5,806	4,543
	Biomedical	Biochem/molecular biol	20,577
Biology	Genetics	4,060	4,231
	Microbiology	4,263	5,681
	Virology	1,999	2,896
	Agric/food science	9,745	7,931
	Animal science	2,444	2,509
	Ecology	2,699	2,516
Earth/Space	Entomology	2,961	2,322
	Environmental science	3,356	4,386
Mathematics	Atmospheric science	1,254	1,567
	Probability/statistics	1,670	1,238

It is clear that funding decisions in developed countries have resulted in substantial growth in research output in some fields and subfields. On the whole, programs related to agriculture have not grown during the last decade with the exception of molecular biology, virology and environmental sciences as measured by scientific articles.

\* Extracted from *Science and Engineering Indicators 1996*, published by the National Science Foundation, Washington, D.C. 352 pp.