CURRICULUM VITAE (Jan. 1994)

I. Name: **Arthur Gerald (Jerry) Matches (retired)**
Address: Dept. Agronomy, Horticulture and Entomology Texas Tech University Lubbock, Texas 79409

II. Date of Birth: Jan. 28, 1929

III. Place of Birth: Portland, Oregon

IV. IV. Educational Background

1948-52 Oregon State University, major, Farm Crops: B.S. 1952
1952-54 Oregon State University, major, Farm Crops; minor, Soils: M.S. 1954
1956-60 Purdue University; major, Crop Physiology & Ecology; minors, Statistics and Animal Nutrition; Ph.D. 1960

V. Professional Experience:

Assistant Agronomist, New Mexico State University, Artesia, New Mexico, 1960-61
Research Agronomist, U.S. Department of Agriculture, Agricultural Research Service, Columbia, MO 1961-81, and
Professor of Agronomy, University of Missouri, Columbia, 1961-81
Thornton Professor, Thornton Distinguished Chair, Department of Plant and Soil Science, Texas Tech University, Lubbock, Texas, 1981-present

VI. Honors and Awards:

- Alpha Zeta
- Phi Sigma
- Gamma Sigma Delta
- Sigma Xi
- American Forage & Grassland Council Merit Certificate - 1960
- Fellow, American Society of Agronomy, 1976
- Gamma Sigma Delta Distinguished Research Award in Agriculture (Univ. of Missouri) - 1981
- Medallion Award of the American Forage and Grassland Council - 1982
- Fellow, Crop Science Society of America - 1985
- Mini-Development Grant, Vice-President Academic Affairs, TTU - 1985 - - Outstanding Researcher, College of Agricultural Science, TTU - 1988
- Outstanding Researcher, College of Agricultural Sciences and Natural Resources, TTU, 1992

VII. Membership in Professional Societies:

- American Society of Agronomy
- Crop Science Society of America
  American Forage and Grassland Council
- American Society of Animal Science - Society for Range Management
- Council for Agricultural Science and Technology - Grassland Society of South Africa

VIII. Officers and Committee Assignments Held in Professional and Honorary Societies:

- Associate Editor, Agronomy Journal, 1969-75

- American Society of Agronomy Liaison Officer to the American Forage and Grassland Council, 1972-75

- American Society of Agronomy representative for the organization of the "Forage Fertilization Symposium" held at Muscle Shoals, Alabama in 1972 (Also served as a reviewer of papers published in the Proceedings)

- Chairman of A-831, Forage and Grassland Technical Committee of the American Society of Agronomy from 1969-73 and a member of this committee from 1973-80

- Chairman, Crop Science Society of America Committee C-496, Award for Outstanding Volunteer Papers, 1973-74

- Elected Chairman Division C-3, Crop Ecology, Production and Management, Crop Science Society of America, 1974-75

- Elected Board of Directors, Crop Science Society of America, 1974-75

- Elected Board of Directors, American Forage and Grassland Council, 1972-75

- Elected 2nd Vice-President and progressed to President-elect and then to President of the American Forage and Grassland Council, 1975-78

- Research Committee of the American Forage and Grassland Council, 1972-75

- Chairman, NCR-31 Regional Committee on Forage Management and Physiology, 1969-70

- Elected Secretary-Treasurer of the University of Missouri-Columbia Chapter of Sigma Xi, 1973-75

Since Coming to Texas Tech University on December 15. 1981:

- Crop Science Society of America liaison person to the American Forage and Grassland Council, 1981-83

- Elected to Board of Directors of the American Society of Agronomy and Crop Science Society of America, 1983-85

- Editorial Board, Crop Science Society of

America - Associate Editor, CROP SCIENCE,

1982-83 - Technical Editor, CROP SCIENCE,

1983-85

- American Forage and Grassland Council
  Mission Committee 1980-82
  Research Committee 1983-86,1991
  Inter-organization Liaison Committee 1981-83
  Publication and Communication Committee, Co-Chair 1986, member to present

- Elected Board Representative of Division C-6 of the Crop Science Society of America 1983-85

- Crop Science Society of America C-452 Dekalb-Pfizer Crop Science Distinguished Career Award Committee 1986, 1987

- Chairperson, Editorial committee for American Society of Agronomy special Publication on Seed Coating 1986-1987

- American Society of Agronomy ACS 824 Forage and Grassland Committee 1986-1988

- Chairman, American Society of Agronomy ACS 824.1 Study Committee on ACS 824 Forage and Grassland 1987-1988

-Chairman, American Society of Agronomy ACS 323.17 Proceedings of a Tri-lateral Workshop on Legume Persistence 1987-1988

- United States Coordinator (Organizer) of a U.S.-Australia-New Zealand Joint Seminar/Workshop on Persistence of Pasture Legumes, University of Hawaii, July 1988 (Proposal submitted to National Science Foundation) 1987, 1988

- Ad Hoc Resource Task Force Committee (C-302-1), Crop Science Society of America 1988

-Chairperson, ASC 824 Forage, Grassland and Range Resource Committee 1989, member 1990-91, (Am. Soc. Agron.)

-Crop Science Society of America CSSA 655.4 Alternate Member to Assoc. Official Seed Certification Agencies for Legumes other than Alfalfa and Sunflower 1988-89 and Member 1990-91

- American Society of Animal Science Special Representative to the American Forage and Grassland Council 1987 to 1993.

-Member of the organizing committee of the First International Crop Science Congress co-sponsored by CSSA and Iowa State University and scheduled for 14 to 22 July 1992.

-Crop Science Soc. of America ad hoc Editorial Board Task Force, 1992.

-Texas Forage and Grassland Council Research and Education Committee,

1992-

-AFGC Pass Presidents Circle

IX. Publications: (See attached list)

X. Books Edited: "Anti-Quality Components of Forages" CSSA Special Publication Number 4. 1973. Crop Science Society of America.

"Persistence of Forage Legumes" Proc. Trilateral Workshop, Honolulu HI. 1989. ASA, CSSA, SSSA, Madison, WI.

XI. Chapters in Books:

"Cropland Pastures" in 3rd Edition of FORAGES. 1973. (Referred Pub. #12)

"Systems of Forage Management" in the 4th Edition of FORAGES. 1985. (Referred Pub. #45)

"Pasture Production and Utilization" (Ch. 16) ASA, CSSA, SSSA. Monograph No. 29. 1988. Served as a co-author (Referred Pub. #53)

"A survey of legume production and persistence in the United States. Proc. Trilateral Workshop; Honolulu, HI. 1989. ASA, CSSA, SSSA, Madison, WI. (See Refereed Pub. # 56).

"Persistence of Forage Legumes" Proc. Trilateral Workshop, Honolulu, HI. 1989. ASA, CSSA, SSSA Madison, WI. (See Refereed Pub. #57).

"Measurement of Animal Response in Grazing Research" CSSA Spec. Pub. 16. 1989. (See Referred Pub. # 59)

XII. Participation in National Scientific Meetings, Technical Conferences. Workshops, etc.: (Presented by A.G. Matches, graduate student, or colleague - see abstract listing)

A. Annual meetings of the American Society of Agronomy and Crop Science Society of America:

-"Tall fescue growth response to differential tiller defoliation", 1964.

-"Quality changes in the accumulated growth of tall fescue", 1966.

-" Influence of cutting height in darkness on estimation of energy reserves of tall fescue", 1968.

-"Use of half-sib testers for error reduction in grazing trials", 1969.

-"Seasonal trends of In vitro digestibility in grazed tall fescue awards", 1970.

- "Evaluation of birdsfoot trefoil varieties under various planting and management systems", 1970.

-"Multiple assignment tester animals for pasture systems trials:, 1972.

- "Autumn-winter yield and quality of tall fescue (Festuca arundinacea Schreb.) ", 1973.

-"Seasonal trends of crude protein and animal performance of grazed tall fescue pastures", 1974.

-"Maximizing returns from tall fescue", 1975.

-"Techniques for evaluating cultivars of temperate grasses", 1977.

-"Combining ability and heritability for perloline content in tall fescue", 1977.

-"Forage yield and quality of switchgrass and caucasian bluestem", 1978.

-"Characterization of allelopathic effects of tall fescue on birdsfoot trefoil", 1980.
-"Forage management - Utilization perspective", 1980 (invited).

Presentations as Author or Co-author Since Coming to Texas Tech University in December, 1981:

- "Temperature effects on seedling development of four warm season forage species", 1982.

- "Integration of subtropical perennial grasses into forage livestock systems", 1982 (invited).

- "Root Growth of forage legumes using the slant-tube technique", 1986.

- "Using the slant-tube technique to predict rooting depth of forage legumes in the field", 1986.

- "Embark effects on growth of forage sorghum cultivars", 1986. -

"Yield, quality and water use of alfalfa and sainfoin", 1987.

- "Wheatgrass and wheatgrass-sainfoin production and quality under different sheep grazing schedules", 1987.

- "Steer gains on Embark treated forage-sorghum pastures", 1987.

- "Root development of forages using the pouch technique", 1987.

- "Impact of temperature on root development of forage legumes", 1988.

-"Water relations of sainfoin and alfalfa under stress", 1988.

-"Digestible organic matter intake of wheatgrasses and wheatgrass-sainfoin mixtures by sheep", 1988.

-"A comparative analysis of two calibration procedures for predicting leaf percentages in forage sorghums using NIRS", 1988.

- "Variability of minerals among three wheatgrasses and sainfoin", 1988.

-"Measurement of the animal in grazing research", 1988.

-"Seasonal shifts in the thermal dependence of glutathione reductase in alfalfa and sainfoin", 1990.

- "Variability among grain sorghums in stover yield and quality", 1990. –

-"Modeling lamb production from wheatgrass/sainfoin pastures", 1990.

-"Sainfoin leaf and stem quality at three growth stages", 1990. "Criteria for marketing lambs off spring pasture, 1991 (invited) "An overview of legume persistence", 1992.

-"Fatty acid composition of doc-fat from lambs grazing alfalfa, sainfoin, and wheatgrasses", 1992.

B. Annual meeting of the American Forage and Grassland Council:

-"Planning forage systems for beef cow-calf production. Use of warmseason grasses in pasture systems with cool-season grasses", 1979 (invited).

C. Annual meeting of the American Society of Animal Science:

-"Grazing research methodology", 1984 (invited). D. International Presentations:

- "Estimating the parameters associated with grazing systems", III World

Conference on Animal Production, Melbourne, Australia, 1973. (invited)

- "Pasture research activities", CSIRO Seminar, Armidale, Australia, 1973.

- "Forage research in progress", New Zealand Ministry of Agriculture and Fisheries, Invermary Agricultural Research Station, Dunedin, New Zealand, 1973. (invited)

- "Role of carbohydrate reserves in forages", Guest lecturer at the Department of Agronomy, Massey University, Palmerston North, New Zealand, 1973. (invited)

- South African Department of Agricultural Technical Services. Seven seminars were given at Agricultural Research Stations located in South Africa between October 23 and November 24, 1978. (invited)

- "Techniques for pasture systems research", University of Pretoria, Pasture Science Department, Pretoria, South Africa, October 20, 1978. (invited)

- "Forage systems research in progress", Agricultural Scientific Association of Natal, Piertermaritzburg, South Africa, November 1, 1978. (invited)

- Invited by the South African Department of Agricultural Technical Services to spend six weeks in South Africa at their expense, review their pasture research, discuss forage-livestock research techniques, and to prepare a report of findings. This trip was taken between October 12 and November 26, 1978.

- Invited participant in an Australian-United States forage workshop on "Forage Evaluation: Concepts and Techniques", which was sponsored by the National Science Foundation. The workshop was held in Armidale, Australia, October 27-31, 1980, and the incumbent was one of eight U.S. scientists invited to participate (Refereed Pubs. # 34, 35, 36, 37).

Since Coming to Texas Tech University in December, 1981:

- "Effect of mefluidide on vegetative growth and root production of forage sorghum", Aug. 29, 1985. Kyoto, Japan (invited).

- Invited participant of a trilateral workshop (USA, Australia, New Zealand) on "Persistence of forage legumes", held in Honolulu, HI, 18-22 July, 1988. (See Referred Pubs. #56 & 57).

- "Contributions of the systems approach to improvement of grassland management." Plenary talk to the 16th International Grassland Congress. October 4-11, 1989. Nice, France. (invited)

- "Growth and quality trends for leaves and stems of two forage sorghums", 1993. 17th International Grassland Congress, Palmerston North, NZ

- "NIRS calibration procedures for predicting leaf percentages from forage

sorghums and pearl millets", 1993. 17th International Grassland Congress, Palmerston North, NZ.

E. Other National Presentations by A.G. Matches: **(invited)**

-"Pasture research methods", National Conference on Forage Quality Evaluation and Utilization, Lincoln, Nebraska, 1969.

- "Legumes in pasture systems", Second Annual Alfalfa Symposium, Mt. Vernon, Missouri, 1972.

- "Post-establishment harvesting and management systems of forages", No-Tillage Forage Symposium, Ohio State University, Columbus, Ohio, 1975.

- "Forage research in northwest Texas", National Trifolium Conference, Corpus Christi, Texas. 24 March, 1988.

- "Root growth (germplasm evaluation techniques)", National Trifolium Conference, Corpus Christi, Texas. 25 March, 1988.

- "Plant response to grazing", Symposium on ecology and management of grazing system. January 14-19, 1989. Am. Assoc. for the Advancement of Science.

- An overview of legume persistence", Crop Science Society of America, Minneapolis, MN, 4 Nov. 1992.

F. Regional Presentations by A.G. Matches: (invited)

- "A review of the role of carbohydrate reserves in the regrowth of coolseason grasses", NCR-31 Forage Management and Physiology Conference, St. Paul, Minnesota, 1969.

- "Considerations in beef cow-calf forage systems research", interdepartmental beef-cow seminar series, Departments of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota, 1973.

- "Forage systems research", Department of Agronomy, Mississippi State University, Mississippi State, Mississippi, April 19, 1976.

- "Multiple assignment tester animals for pasture animal systems", Physiology-Ecology Workshop, 33rd Annual Southern Pasture and Forage Crop Improvement Conference, Mississippi State, Mississippi, April 20, 1976.

- "Grazing studies in Missouri", General Session 33rd Annual Southern Pasture and Forage Crop Improvement Conference, Mississippi State, Mississippi, April 22, 1976.

- "Forage research", Crop Science Seminar, Department of Agronomy, Agriculture Science Center, University of Kentucky, Lexington, Kentucky, December 1, 1977.

- "Research with forage systems for the beef cow herd", First Annual Virginia Forage and Grassland Conference, Staunton, Virginia, March 30, 1978.
- "Measuring forage quality with grazing animals", University of Nebraska, Lincoln, Nebraska, April 26, 1978.

- "Pasture research techniques", University of Nebraska, Departments of Agronomy and Animal Science, Lincoln, Nebraska, April 26, 1978.

Since Coming to Texas Tech University on December 15, 1981:

- "Forage Systems", University of Nebraska - Lincoln, April 17, 1985.

- "Texas Tech forage research programs", University of Nebraska - Lincoln, April 18, 1985.

- "Forage-livestock systems", Kansas State University - Manhattan, April 15, 1985.

- "Annual legume evaluation in the semi-arid High Plains", USDA-ARS Annual Legume Workshop, El Reno, Oklahoma, May, 1986.

- "Proper techniques in grazing trials", Southern Section American Society of Animal Science, February, 1986.

-"Pasture research techniques in grazing management research", Southern Forage and Pasture Crop Improvement Conference, Clemson University, April, 1987.

-"Objectives of grazing research and their implication for experimental design", 44th Southern Pasture and Forage Crop Improvement Conf 1012 March, 1988, Lexington, Kentucky (invited).

- "Potential of sainfoin for the Southern Great Plains", Eleventh Trifolium Conf., Silver Falls Conf. Ctr., Sublimity, OR. 9-1 July 1990.

- "Forage evaluation on the High Plains", Southern Pasture and Forage Crops Improvement Conf., Overton, TX. 7-10 May 1990

- "Forage agriculture on the Southern High Plains", Southern Pasture and Forage Crop Improvement Conf., Overton, TX. 7-10 May 1990.

-"Forage sorghum management", Total Forage Management Symposium, Texas A&M Research and Extension Center, Amarillo, TX. 18 Feb. 1992.

-"Yield and quality of grain sorghum stover", Total Forage Management Symposium, Texas A&M Research and Extension Center, Amarillo, TX. 18 Feb. 1992.

-"Early Missouri interdisciplinary forage research - Why and How?" Forage/Livestock Research-Extension Group, Univ.of Missouri, Columbia, MO, Oct. 18, 1993.

G. Local meetings and seminars:

-"Forages for cropping systems and conservation", Soil Conservation Service Technical Operators Planning Workshop, Columbia, Missouri, 1961.

- "Missouri pastures-past, present, and future", Twenty-sixth Annual Livestock Day, University of Missouri, Columbia, Missouri, 1964. (nvited)

-" Problems of forage legume seed production in Missouri", Forty-fifth Annual Meeting, Missouri Seed Improvement Association, Columbia, Missouri, 1964.

- "Forage evaluation research", Agricultural Science Week, University of Missouri, Animal Nutrition Seminar, Columbia, Missouri, 1965.

-"Tall fescue for summer and winter pasture", Meeting of district Agricultural Alumni, College of Agriculture, University of Missouri, Columbia, Missouri, 1966.

- "Forage production-Australia and New Zealand", Soil Conservation Society of America, Show-Me Chapter Annual Meeting, Columbia, Missouri, 1973.

- "Forage systems", Fourth Annual Southwest Missouri Young Farmers Institute, Mt. Vernon, Missouri, 1974.

-"Pasture systems", Bankers Short Course, Department of Agricultural Economics, University of Missouri, Columbia, Missouri, May 24, 1976.

-"Grazing systems", Governor's Advisory Council on Agriculture (attended by Missouri's Governor Bond), University of Missouri Southwest Center, Mt. Vernon, Missouri, July 15, 1976.

-"Forage panel", Cow-calf Clinic, Animal Husbandry Department, University of Missouri, Columbia, Missouri, July 19, 1976.

-Panel "Strategies for dealing with weather adversity: livestock systems", Climatic-Technology Seminar, College of Agriculture, University of Missouri, Columbia, Missouri, October 25-26, 1977.

-"Forage and livestock management of cool-season grasses and legumes", U.S. Forest Service, Mark Twain National Forest Range Workshop, Fulton,

Missouri, May 23, 1978.

-"Forage research in South Africa", Animal Husbandry Department, University of Missouri, Columbia, Missouri, March 5, 1979.

-Panel "Reducing erosion on pasture land", Thirty-second Annual Summer Training Conference. Missouri Department of Natural Resources; Soil and Water Districts Commission; and Association of Soil and Water Conservation Districts, Jefferson City, Missouri, August 4, 1980.

Since Coming to Texas Tech University on December 15. 1981:

-"Legumes", a panel discussion presented at the Soil Conservation Workshop, Fort Worth, Texas, March 11, 1983.

-"Pasture management strategies to improve beef productivity---means and methods in West Texas", presented to the Western Cattle Raisers Association in Austin, Texas, March 22, 1983.

- "Our role and obligation in research", Texas Tech University, PSS Seminar, September 12, 1983.

- "Integrated forage - livestock systems: past, present and future direction", 20th Annual Ranch Management Conference. TTU, Lubbock, Texas, September 30, 1983.

- Keynote address entitled, "Small Plot Dilemma - Does it Exist?", Texas Forage Workers Conference, Dallas, Texas, November 2, 1983.

- Moderator of a special session on "Grazing Systems", 1983 Forage and Grassland Conference AFGC, Houston, Texas, January 25, 1984.

- "Forage research program - PSS", College of Agricultural Sciences, TTU Advisory Committee, Lubbock, Texas, May 31, 1984.

- "Pasture research methods", Texas Forage Workers Conference, Overton, Texas, April 23, 1985 (invited).

- "Report on the Texas Tech University Forage Research Program", Texas A&M University, College Station, Texas, November 25-27, 1985 (invited).

- "Forage research: goals and experiments", Graduate seminar, Dept. Animal Science, February, 1986.

-"Research methods for pasture and forage research", Animal Science 5303. Ops. 1987. Animal Science Dept., Texas Tech University.

-"Plant response to grazing-implications on forage evaluation", Dept. of Agronomy, Horticulture and Entomology, Texas Tech University, February, 1989.

- "Plant responses to grazing", R&WM 3303. Range and Wildlife Management Department, Texas Tech University, February, 1989.

- "Plant responses to grazing", ANSC 4301, Animal Science Department, Texas Tech University, March, 1989.

- "Forae sorghum management", Total Forage Management Symposium, Texas A&M Agric. Res. and Ext. Ctr, Amarillo, TX, 1992.

-"Yield and quality of grain sorghum stover", Total Forage Management Symposium, Texas A&M Agric. Res. and Ext. Ctr, Amarillo, TX, 1992.

-"Forage research", Texas A&M Agric. Res. and Ext Ctr, Lubbock, Tx, 1992,

H. Local training programs:

- "Current research on pasture grasses", Department of Animal Husbandry Nutrition Seminar for County Extension Staff, University of Missouri, Columbia, Missouri, 1965.

- "Pasture grasses and forage research", Short Course for New Field Crop ExtensionAgents, University of Missouri, Columbia, Missouri, 1966.

- "Forage research: Past, present, and future", Extension Crops and Soils Conference, Texas and Howard Counties, Houston, Missouri, 1969.

- "Tall fescue for winter pasture", Agronomy Agent Training Course, University of Missouri, Columbia, Missouri, 1969.

- "Forage analysis as affected by different treatments and managements", University of Missouri Area Livestock Specialists In-Service Training Conference, Number 37, Brookfield, Missouri, 1973.

- "Forage systems", Forage Management Symposium for In-Service Training Activity for Teachers of Vocational Agriculture in Southwest Missouri, Mt. Vernon, Missouri, 1973.

- "Forage systems for the summer slump", In-Service Training for Area Agronomists and Livestock Specialists, University of Missouri, Columbia, Missouri, 1974.

XIII. Technical Advisory Activity with USDA:

- Served as TA for Humid Pasture Production in the North Central Region from July 1974 to September 1975 and served in this capacity on a national basis until February 1981.

- Requested by the Assistant Administrator for Plant and Entomological Sciences to Participate in the program review of the USDA-ARS Meat Animal Research Center, Clay Center, Nebraska, December 2-4, 1974.

- Serves as the ARS representative on the North Central Regional Committee NCR-3 1, Forage Management and Physiology.

- Participant in the ARS Plant and Entomological Society TA Workshop, November 11-13, 1975, at which time I was assigned the task of drafting the NRP for Humid Pasture Production and Management for the USDA.

- By invitation served as a member of the North Central Region Dairy Management-Forage Task Force Committee as one of three scientists representing the forage area. This 11-member committee met on the University of Wisconsin Campus, Madison, Wisconsin, November 20-21, 1974.

- Invited by the University of Nebraska-Lincoln, Institute of Agriculture and National Resources to serve on the joint NAES-ARS Review and Projection of the Nebraska-based Forage Production Research Program March 21-22, 1974. (Serious illness and hospitalization of incumbent's spouse shortly before this review prevented him from attending).

- Reviewed and evaluated research proposals to be selected for funding under P.L. 89-106 at the request of the USDA, Cooperative State Research Service, April 1975.

- From May 1976 to December 1981, TA activities included serving on an alfalfa workshop held in St. Paul, Minnesota; research planning for the U.S. Regional Pasture Laboratory in Pennsylvania; a feasibility study for forage and pasture research at Booneville, Arkansas; chairman of a tall fescue toxicosis workshop in Atlanta, Georgia and for a follow-up work meeting at Mt. Vernon, Missouri; site committee for the Dairy-Forage Research Center in Wisconsin.

- Served as Technical Advisor to the National Ad Hoc Committee for a feasibility study of a cooperative state/federal crop residue/forage/meat animal research center, 1979.

- Designated as "principal investigator" in the United States by the USDA for the U.S.-Spain Cooperative program on red meat production, Project 7.3. Incumbent went to Spain in 1980 to review this research.

- Served as ADODR on Cooperative Agreement ARS-3042-2500, CRIS Project 3090-20101-003A "Forage Legume Improvement", Department of Agronomy, University of Missouri.

- <u>Special Assignments:</u>

At the request of the Assistant Administrator, Plant and Entomological Sciences, ARS, served as interim coordinator for Forage and Range and spent a week with the Program Analysis and Coordination Staff in Beltsville, Maryland, developing research programs (RP's) for Forage and Range, March 24-28, 1975.

XIV. Other Significant Information:

- The incumbent was guest of the Department of Scientific and Industrial Research (DSIR), Grasslands Division, Palmerston North, New Zealand from June to August 1973. During this stay, methodology of grassland research was studied with DSIR scientists of both the Grasslands and Applied Biochemistry Divisions.

- Pasture scientists from the University of Natal, Pietermaritzburg, South Africa. (one from 1971-72, and another from 1974-75) and two scientists from DSIR, Grasslands Division, Christchurch, New Zealand (1975-76), and Gore New Zealand (1980-81) have each spent 9 months to a year in Missouri to study and work with the incumbent in his pasture research program.

- By invitation, the incumbent has presided at a number of sessions of technical papers at the annual meetings of the Crop Science Society of America, the Forage Fertility Symposium, and at the Research and Industry conference of the American Forage and Grassland Council.

- The incumbent organized, in 1967, an interdisciplinary forage-livestock researchextension discussion group at the University of Missouri and maintained weekly noon meetings of the group until Dec. 1981. Regularly, twenty to thirty research scientists, extension specialists and graduate students from the Departments of Agronomy, Animal Husbandry, Dairy Husbandry, Agricultural Biochemistry, Agricultural Economics and Entomology attended these meetings. The incumbent provided the leadership for this discussion group over the years.

- The incumbent has participated in reporting research results at an average of two field days a year of the Missouri Agricultural Experiment Station from 1961 to 1981.

- The incumbent is frequently requested to give guest lectures on topics related to forage management in classes and seminars at the University of Missouri and Texas Tech University.

- From 1961 to 1981, the incumbent served as the project leader for the Missouri AES HATCH Project MO-00367 entitled Development of Improved ForageLivestock Systems and Plant-Animal Research Techniques. He conducted cooperative studies on forage quality with Missouri AES biochemists; cooperative studies on forage-fed beef with Missouri AES Animal Husbandry and Food Science and Nutrition scientists and Agricultural Economists; and cooperated with Missouri AES Agricultural Engineers on quality of preserved forages. The incumbent also served as a consultant for scientists and graduate students of the University of Missouri Fisheries and Wildlife Department and Missouri Conservation Commission on measurement of yield and quality of prairie herbage.

- The incumbent has served on more than 30 M.S. and Ph.D. graduate committees at the University of Missouri and Texas Tech University.

- The incumbent has served as the graduate committee chairman and dissertation supervisor for 10 M.S. and 13 Ph.D. candidates at the University of Missouri and Texas Tech University

XV. Committees at Texas Tech University:

A. University

- Faculty Grievance Panel; September 1, 1983 - August 31, 1984.

- Vice-President Academic Affairs ad Hoc Committees:
  - Exigency Policy committee - Redrafting of Exigency Policy

- Vice-President Academic Affairs ad Hoc Research Advisory Committee; 1987.

- Elected to represent the College of Agricultural Sciences on the TTU Graduate Council for a 3 year term (Sept 1992-'95).

B. College

-Chairman, College of Agricultural Sciences Tenure, Promotion, and Exit Committee; 1984-85, 1985-86, 1986-87, 1987-88, Member 1988-89.

-Chairman, Agronomy, Horticulture and Entomology Search Committee for new department chairperson (appointed 18 December 1989).

-Interim research leader and chairman of the research committee for Department of Agronomy, Horticulture and Entomology (appointed 18 December 1989 to present).

-Texas Tech University representative on the steering committee of the Southwest Consortium on Plant Genetics and Water Resources (appointed 16 March 1990).

-Plant Stress Laboratory Site Committee, College of Agricultural Sciences (appointed February 1990).

- Chairman, College of Agricultural Sciences Graduate Studies Coordination Committee (Appointed Sept. 1992)

C. Department

- Supervisor and manager of the PSS Campus Farm and Facilities: 1986-present. - Departmental Awards Committee

- Misc. Departmental Committees (5 others)

- Acting Research Leader, Department of Agronomy, Horticulture, and Entomology, Dec. 1989-1991.

- Graduate Council, representative for the Dept. of AHE, 1992.

XVI. Research Grants Received Since 1982:

- USDA -ARS: $99,718

- USDA - ARS: $90,883

- Texas Agricultural Experiment Station: $67,600 + 30,800

- American Cyanamid: $3,600

- 3-M Co.: $23,000

- Texas Tech University mini-development grant $800

- National Science Foundation- U.S., New Zealand and Australia, Joint seminar on "Persistence of Pasture Legumes", $15,462

- USDA-ARS: $97,615 (Plant Stress Inst.)

TOTAL: $420,482

XVII. Graduate Student Advising at Texas Tech University since 1982

A. Chairman of Graduate Committee:	M. S.	Ph.D.
Rolando Hernandez	1984	
Custudio L. Bojorquez	1986	
Danny P. Mowrey	1986	1989
Terrence C. Bolger		1988
Thomas C. Griggs		1988
Arturo Martinez		1987
T. Peter Karnezos		1990
Robert L. Kallenbach (expected)		1994

B. Have served on 22 other M.S. and Ph.D. committees to date at Texas Tech University.

XVIII. Post-Doctoral Scientists in Dr. Matches Research Program at Texas Tech University:

A. Dr. David I. Bransby (South Africa) 1984

B. Dr. Saranga P. Kidambi 1987-88 and 1988-90

C. T. P. Karnezos 1991-1993

XIX. Courses Taught:

AGRO 3321	Forage and Pasture Crops
AGRO 5327	Forage-Livestock Research Methods
AGRO 6000	Master's Thesis
AGRO 6002	Selected Topics in Crop Science
AGRO 7000	Research
AGRO 8000	Doctor's Dissertation

XX. Other:

Invited participant by the National Academy of Science, Nat. Res. Council and USDAARS. "Project 2000" Workshop on Plant Breeding Approaches and Application of Molecular Biology to Intractable Problems in Crop Improvement. Denver, Colorado. June 26-28, and at Irvine, CA. 24-26 Jan. 1990.

XXI. Research Accomplishments:

The incumbent has been engaged in research on forage and pasture management since 1961. He has published extensively and made many presentations, which has led to national and international recognition of his research program. International status in pasture research is shown by such invitations as: to present a paper in Australia in 1973 at the 3rd world Conference on Animal Production; to spend over two months in 1973 as guest of D.S.I.R., Grasslands Division in Palmerston, North, New Zealand; to evaluate on site in 1978 pasture research of the Republic of South Africa and to suggest improvements particularly in their research techniques; and in 1980, he was one of eight U.S. scientists invited to participate in Australia with Australian scientists on a C.S.I.R.O. - N.S.F. sponsored workshop entitled "Forage Evaluations - Concepts and Techniques". He served as USDA's principal investigator on a cooperative U.S.-Spain grazing experiment located in Spain. Also, he was elected Fellow of the American Society of Agronomy in 1976 and received the American Forage and Grassland Council's Medallion Award in 1982.

His research has placed particular emphasis on two problem areas: (1) species and management practices that will provide forage and pasture at times of the year when the quantity of high quality forage is normally low or non-existent, and (2) the development and refinement of research techniques for the evaluation of forages in small-plot and grazing trials, and methods for the reduction of experimental error in grazing trials.

His development of several alternative pasture systems to supply forage during the summer slump are being adopted by farmers in Missouri and the Southern Corn Belt. Use of his multiple assignment tester animal concept and

field designs for pasture systems trials are being applied by scientists in many parts of the world. Likewise, his extensive management and utilization research on tall fescue has been recognized by invitational authorship of a chapter on "Management" of tall fescue in a published monograph (publication #79).

Specific examples of accomplishments are as follows:

A. Tall fescue normally makes good growth during the spring and autumn, but little growth occurs during the summer in much of the southern Corn Belt. The incumbent's research was one of the first to characterize the morphological (bud and tiller) development of tall fescue and to indicate cause and effect relationships of endogenous growth regulators on bud elongation and tiller development of tall fescue. The endogenous growth regulator findings are particularly important since the earlier research showed an abundance of buds on the stem bases and nodes of tall fescue going into the summer, but most of these buds failed to elongate into new tillers during that growing season. The endogenous growth regulators appeared to control the further development of buds. This research has provided new insights for managing tall fescue for improved summer production.

B. In grazing experiments, the pasture to pasture variation for production per animal generally has a coefficient of variation (CV) of from 5 to 10%, whereas the animal to animal source of variation generally ranges in CV's from 10 to 30%. Thus reducing the animal source of variations offers the greatest opportunity for increasing the precision of grazing experiments. The incumbent examined the use of half-sib tester animals for error reduction and showed that by using half-sib testers, statistical efficiency may be increased up to 300% for average daily gain and up to 600% for gain per ha when compared to using unrelated tester animals. This research demonstrates that half-sib testers are one method that experimenters have to help control the animal source of variation in grazing experiments, and this will permit the detection of small differences among treatments as being statistically different in grazing experiments.

C. The incumbent recognized that components of pasture systems cannot be grazed independently and provide information indicative of expected animal performance when components are combined and grazed as pasture systems, However, little has been published on research techniques for pasture system grazing experiments. The incumbent conceived a multiple-assignment tester animal technique with different field designs for season-long pasture system experiments which measures the season-long response of cattle performance. This allows the simultaneous comparison of several pasture systems; requires fewer pastures per replication and thus reduces the experimental costs; and provides the producer with information on season-long performance which is more realistic for planning pasture systems best suited for his farm or ranch conditions.

D. The incumbent recognized that an uneven seasonal distribution of pasture production is a major factor limiting cattle production in the southern Corn Belt. In long-term research, the incumbent has systematically evaluated in spaced plant plantings, in small-plots, and in grazing experiments the use of different combinations of cool- and warm-season forages (grasses, legumes, and mixtures) combined with different management practices for providing forage and grazing

during the summer slump in pasture availability. From this research, he has developed and continued to refine pasture system options. Farmers in the mid-west are now rapidly adopting these systems, and this has nearly eliminated their summer slump problem. Similar systems are being researched at Texas Tech University.

E. Tall fescue is a comparatively recent introduced cool-season grass which is now widely grown throughout the southern Corn Belt. The incumbent and his graduate students were the first to characterize the stockpiled growth of tall fescue, show its trends in quality through the winter and identify environmental factors associated with losses of liom 14 to 34% in herbage dry matter and forage quality during the winter. From this research improved management practices were developed for stockpiling tall fescue and improved utilization schemes proposed to reduce losses during the winter.

F. Inconsistent results have been encountered in obtaining successful stands of birdsfoot trefoil when sod-seeded into established stands of tall fescue. Competition for water, nutrients and light did not fully explain the poor stands, but tall fescue is known to sometimes contain unidentified allelopathic substances. The incumbent and his graduate students investigated in laboratory, greenhouse and field studies the influence of N fertilization, fescue residue management and time of year on the allelopathic effects of tall fescue. For the first time, seasonal trends for allelopathy were characterized and allelopathic substances identified which are believed responsible for the suppression of trefoil germination and seedling development. From this research, new fertilization and residue management practices have been formulated for the sod-seeding of trefoil into sods of tall fescue.

G. As a team member, the incumbent has participated in comprehensive forage-livestock research evaluating the potential of producing forage-fed beef. Thirteen different systems of producing beef were compared. Cattle gains on pasture were 28 to 31 % greater on tall fescue plus legumes vs. tall fescue grown alone; steers fed silage and grain in dry lot required the least days to slaughter; and flavor, tenderness and overall acceptability of steaks were influenced by the pasture-feeding system. From these research findings, producers and packers have a better basis for choosing beef production systems which minimize the feeding of grain but still produce a quality of meat acceptable to the consumer.

H . Changes in animal weights are an indicator of the effects of treatment variables in grazing experiments. However, short term variation in animal live weights due to fluctuations in gut fill may mask measurement of true body weight. The incumbent demonstrated from his grazing experiments that within individual weigh periods that correlation's were high between animal fill and shrunk weights, but correlation's for animal gain and estimated TDN consumption between computations based on fill and shrunk weights were low. Over long grazing periods, fill and shrunk weights were equally sensitive in directing treatment differences in grazing experiments, but shrunk weights may be advantageous in short term grazing experiments. This research provides pasture researchers a better basis on whether to take fill or shrunk weights in their grazing experiments.

I . The incumbent investigated whether it is necessary to use animal defoliation rather than mowing in order to obtain meaningful measurements of plant response in preliminary evaluations of new forages or management practices. The findings showed that when relative rankings among forages or treatments for yield are of primary concern, the less costly mowing techniques are suitable (providing soil fertility is maintained at non-limiting levels) for selecting out the superior entries or treatments for more comprehensive evaluation in costly grazing trials.

J . Because regrowth in darkness is used by many researchers as an indicator of the energy status (mainly carbohydrate reserves) of forage plants exposed to different clipping-grazing management practices, the incumbent examined the techniques used in measuring etiolated regrowth. He showed that the stubble height used in measuring etiolated regrowth must be standardized so that results are comparable from one experiment to another.

K . The incumbent has clarified, by placing into proper perspective, the use of the fixed and variable stocking rate methods of experimentation in accordance to the parameters to be measured and the objectives of cattle grazing experiments. As a result, less controversy now exists worldwide among pasture researchers as to whether a fixed or variable rate of stocking should be used in conducting grazing experiments.

L. The incumbent directed research of his graduate student and a post-doctoral fellow in modifying and testing a disk meter for estimating pasture yields of dry matter. The application and limitations of this meter were described. From this research has come a rapid method for measuring pasture herbage yields in <u>situ.</u>

M. As a team member, the incumbent provided the forage management and quality inputs on research to define selection criteria for breeding improved cultivars of tall fescue and orchardgrass. These studies showed that selecting for narrow-leaf plants results in fescue plants with higher tillering capacity than does selecting for wide leaf plants. With orchardgrass, the research findings indicated that it may be difficult through plant breeding to either increase digestibility or lower fiber content on the regrowth herbage without a corresponding decrease in dry matter yield.

<u>Additional accomplishments since 1981 in the forage research program of the incumbent with his graduate students, post doctoral research associates, and cooperators at Texas Tech University include:</u>

N. Because of their extremely rapid rate of growth, forage sorghums may advance to stages of maturity which are undesirable for grazing within a short interval of time. In research with Embark (mefluidide), a plant growth regulator which delays reproductive growth, the incumbent and graduate students found that: Embark applied at the proper rate and stage of growth of forage sorghum will: a) maintain longer the forage sorghum in a stage desirable for grazing, and b) may improve crude protein content and decrease fiber content of the forage. Additional research with a post-doctoral scientist showed that lamb gains when fed green-chop Embark treated forage sorghum had up to 14% higher feed intake, over 300% higher average <u>daily</u> gain and 265% higher gain/A than the

control. In two years of grazing no benefit was found by the incumbent from treating forage sorghum pastures with Embark because both the control and treated pastures and similar yields of leaf material/A. Thus economic benefits from using Embark are only apparent when forage sorghums are green-chopped and fed to lambs in confinement because the lambs can not be as selective as when grazing.

0. The first-last grazer scheme of rotational grazing is effectively used with humid pastures to achieve different levels of animal performance. However, in research on native buffalograss range at Pantex, the incumbent and graduate students showed no benefit in steer gains or animal gains/A from using the first-last method. Also, there was no benefit of using rotational grazing over continuous grazing on this shortgrass prairie. This means that fencing, watering facilities and cattle handling costs would be less with continuous grazing and animal performance can be expected to equal that from rotational grazing.

P . Research with winter annual legumes has identified several species and cultivars which provide high quality forage at a time when high quality standing forage is not normally available. Self-reseeding winter annual legumes could be expected to greatly improve animal performance on winter pastures of standing dormant grass.

Q. Extensive research with wheatgrass species and cultivars has identified several that offer much potential for filling gaps in pasture availability during early spring and again in the autumn. This will give ranchers greater latitude in managing livestock programs for better animal performance and better marketing opportunities.

R. Management research with both cool-season grasses and perennial legumes indicated that sainfoin (a legume) is compatible with those wheatgrasses that are adapted to the High Plains. Lamb production is greatly improved when sainfoin is grown in a mixture with these grasses (32-81 % greater average daily gain and 94% greater lamb production/ha). These findings indicate that wheatgrass-sainfoin in irrigated pastures offer opportunities for profitable spring lamb production on the Southern High Plains of Texas.

S. Slant-tube research (cooperative with the USDA-ARS) with seedlings in the greenhouse has shown that forage species differ greatly in rate of root growth (elongation). Identification of forage species with superior rates of root growth are expected to embrace the changes for successful seedling establishment under field conditions. The slant-tube and growth pouch techniques accurately identifies which species will also have superior root growth in the field. Thus, these methods will be used to screen forage germplasm from world collections of plant material centers as potential forage for West Texas which may better cope with the environmental stresses of the and High Plains.

T. High variability in the germination and root development (main axis length and lateral roots) of annual and perennial legumes have been shown to be highly temperature regulated for some legumes (Cooperative research with the USDA-ARS). These findings are useful for the identification of legumes to fit specific environments.

U. Gradient irrigation research on alfalfa and sainfoin of the incumbent and his

graduate students has shown that sainfoin does not effectively use irrigation applied during the hot summer months of July and August. Ranchers presently irrigating sainfoin during this period would make better use of their water by applying it to another forage such as alfalfa. However, sainfoin has high water-use efficiency of water applied during the spring.

V. Grazing and cutting experiments have shown that poor persistence of sainfoin is related to specific stages of plant growth and severity of defoliation. When only 70% or less of the standing herbage is removed, satisfactory stands of sainfoin have been maintained. Allowing plants to reseed naturally resulted in improved stands. The latter is a practical management practice that producers may use to maintain stands of sainfoin.

W . Herbage allowance grazing trials with dwarf pearl millet show that it provides excellent summer pasture for lambs and that optimum animal performance might be expected at an allowance (dry matter) of 6-8% of lamb body weight.

X . Thermal kinetic window research (cooperative with USDA-ARS) with alfalfa and sainfoin suggests specific enzyme regulated responses which may account for the growth response differences among cultivars of alfalfa and sainfoin and among sainfoin species. Such information may be useful for identifying alfalfa and sainfoin genotypes for the stressful environments of the Southern Great Plains.

Y. Cooperative investigations with Dr. J. W. Keeling of the Texas Agricultural Experiment Station have shown that wheat and rye are more dependable than winter annual legumes for soil stabilization in cotton fields during the winter. However, Austrian winterpea, hairy vetch, rose clover and certain subterranean clovers provide excellent ground cover if fall rains are near normal.

Z. Grain sorghum stover is commonly grazed following the grain harvest in many areas of the Great Plains. Little was known about the variability in stover yield and quality among sorghum hybrid and inbred lines. In cooperation with Dr. J.W. Keeling and Dr. T. Rosenow (both with the TAES) we found that among 36 grain sorghums that standing stover had leaf percentages ranging from 6 to 56%, total dry matter yields from 1733 to 7963 kg./ha. and leaf yields from 270 to 3003 kg/ha. These findings indicate much potential for improving the stover yield and quality of sorghums through plant breeding. If grazing of stover is planned following a grain harvest, careful consideration should be given to the commercially available hybrid selected for planting.

AA. Over two grazing seasons averaging 88 days, daily gains (0.35 1b) and gain per acre (720 lb) for spring lambs grazing irrigated pastures of alfalfa and sainfoin were not different ($P > 0.05$). In contrast, average daily gain on 'Luna' pubescent wheatgrass was 0.22 lb and from Luna-sainfoin 0.27 lb, and gains/A were 466 and 579 lb, respectively. For lambs purchased and sold for $0.62 per pound, projected gross margins/A were: alfalfa, $258; sainfoin, $277; Luna-sainfoin, $179; and Luna, $106. These results show that spring lamb production (April into July) offer viable opportunities for producers on the Southern High Plains of Texas.

AB. Supplementing lambs grazing alfalfa with 0.3 and 0.6 lb of corn per head per day resulted in a gross margin increase of $40 per acre with each 0.3 lb of corn. The irrigated pastures were grazed from April to July. These small amounts of

energy supplementation gave a linear increase in lamb average daily gain.

AC. Alfalfa cultivar and harvest management trials indicate that cultivar hay yields may differ by as much as 1.81 T/A and yields due to cutting management may differ by as much as 2.42 T/A. The cultivar trials have been conducted for five years and the management trials for three years. Generally, cultivars recommended by industry for planting on the Southern High Plains of Texas will give favorable yields. Results from management trials will provide the basis for recommending cutting management to provide high forage yields of excellent forage quality.

AD. Growth chamber and greenhouse experiments with sainfoin grown under different temperatures and cutting heights are providing useful information of why field stands of sainfoin sometimes are of short duration. For example, high ambient temperature and/or high root temperatures resulted in greatly reduced fine root production off the tap root and in some cases death of plants. This corresponds to severe stand losses that we have observed in the field when sainfoin is cut and periods of high temperature occur during the early regrowth of sainfoin. Cutting at a close stubble (2-3 cm) height also has been found detrimental to fine root production and persistence of plants grown in the greenhouse. Inhibition or loss of fine roots could be expected to reduce water and nutrient uptake and cause a reduction in nitrogen fixation potential. We frequently see reduced nitrogen fixation in field grown sainfoin. Carbohydrate and enzyme analyses are yielding surprises and possible explanations on how sainfoin responds to high temperature and close defoliation.