Curriculum Vitae

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A. Educational Background

B.S. Agronomy-Natural Science, 1978, University of Wisconsin, Madison
M.S. Crop Physiology, 1980, University of Missouri, Columbia
Ph.D. Crop Physiology, 1983, University of Missouri, Columbia

B. Professional Positions Held

1992-pres.	Assistant Head, Agronomy Dept., Purdue University, West Lafayette, IN
1992-pres.	Professor, Agronomy Department, Purdue University, West Lafayette, IN
1987-1992	Associate Professor, Agronomy Department, Purdue University, West Lafayette, Indiana
1983-1987	Assistant Professor, Agronomy Department, Purdue University, West Lafayette, Indiana
1979-1983	Graduate Research Assistant, University of Missouri, Columbia
1975-1979	Undergraduate Research Assistant, University of Wisconsin, Madison

C. Membership in Academic, Professional and Scholastic Societies

American Society of Agronomy
Crop Science Society of America
American Society of Plant Physiologists
Sigma Xi
Gamma Sigma Delta
American Association for the Advancement of Science
Indiana Forage Council
American Forage and Grassland Council
Council for Agricultural Science and Technology

D. Awards and Honors

2006	Graduate Research Faculty Member, University of Tasmania
2006	Certificate of Distinction, e-Courseware Development, Amer. Soc. Agronomy
2005	Outstanding Teaching Award, Purdue University Department of Agronomy (also 1994, 1997, 2001, 2004)
2005-2009	Nonresident Fellow, Samuel Roberts Noble Foundation
2002	Outstanding Undergraduate Counselor Award, Dept. of Agronomy (also 2000)

1998	Merit Award, American Forage and Grassland Council
1997	Fellow, American Association for the Advancement of Science
1993-1994	Research Fellow, AFRC Institute of Grassland and Environmental Research
1993	CIBA-GEIGY Award in Agronomy
1993	Fellow, American Society of Agronomy
1993	Fellow, Crop Science Society of America
1993	Purdue University Agricultural Research Award
1992	Young Crop Scientist Award, Crop Science Society of America
1992-1993	Fellow, Experiment Station Committee on Organization and Policy (ESCOP)
1991	Indiana Forage Council Merit Award for Outstanding Contributions in Forage Science
1983	Outstanding Research Assistant, University of Missouri-Columbia

E. Service to Professional Organizations

2007-2008	*Agronomy Journal* Review Team
2007-2008	*Crop Science* Advisory Team
2006-2007	Publication Review Committee, Crop Science Society of America
2005-2006	C-6 Committee on Forage Science Policy and Funding
2004-2006	CSSA Fellows Selection Committee (also 1996 to 1998)
2004-2009	Associate Editor, *Crop Science* (also 1987 to 1991)
2002-2003	Member, Appl. Turfgrass Science e-Journal Feasibility Comm., CSSA
2000-2002	Member, Forage and Grazinglands e-Journal Feasibility Comm., CSSA
1999-2002	Member, Crop Management e-Journal Feasibility Comm., CSSA
1998-2003	Editor-in-Chief, CSSA
1998-2003	Member of the CSSA Board of Directors
1998-2003	Chair C301, Editorial Affairs, Policies and Practices, CSSA
1998-2003	Member Monographs Committee, ASA
1998-2003	Member, ACS 321 Editorial Policy Coordination, ASA
1998-2003	Member Editorial Board, JNRLSE
1996-1998	Editor, *Crop Science*
1992-1996	Technical Editor, *Crop Science*
1992	Chair, Symposium on Legume Persistence, CSSA
1992	Chair, Division C-2 Crop Physiology and Metabolism, CSSA

F. List of Publications

Refereed journal papers

1. Volenec, J.J., Dale Smith, H.W. Ream, and R.M. Soberalske. 1979. Greenhouse alfalfa yields with single and split applications of deproteinized alfalfa juice. Agron. J. 71:695-697.
2. Volenec, J.J., and C.J. Nelson. 1980. Leaf growth dynamics in tall fescue. Trans. MO. Acad. Sci. 14:180.
3. Volenec, J.J., and C.J. Nelson. 1981. Cell dynamics in leaf meristems of contrasting tall fescue genotypes. Crop Sci. 21:381-385.
4. Volenec, J.J., and C.J. Nelson. 1982. Diurnal leaf elongation of tall fescue genotypes. Crop Sci. 22:531-535.

5. Moser, L.E., J.J. Volenec, and C.J. Nelson. 1982. Respiration, carbohydrate content, and leaf growth of tall fescue. Crop Sci. 22:781-786.
6. Volenec, J.J., and C.J. Nelson. 1983. Response of tall fescue leaf meristems to N fertilization and harvest frequency. Crop Sci. 23:720-724.
7. Volenec, J.J, and C.J. Nelson. 1984. Carbohydrate metabolism in leaf meristems of tall fescue. I. Relationship to genetically altered leaf elongation rates. Plant Physiol. 74:590-594.
8. Volenec, J.J., and C.J. Nelson. 1984. Carbohydrate metabolism in leaf meristems of tall fescue. II. Relationship to leaf elongation rates modified by nitrogen fertilization. Plant Physiol. 74:595-600.
9. Volenec, J.J., C.J. Nelson, and D.A. Sleper. 1984. Influence of temperature on leaf dark respiration of diverse tall fescue genotypes. Crop Sci. 24:907-912.
10. Volenec, J.J., H.T. Nguyen, C.J. Nelson, and D.A. Sleper. 1984. Potential for genetically modifying dark respiration of tall fescue leaves. Crop Sci. 24:938-943.
11. Cherney, J.H., J.J. Volenec, and K.J. Moore. 1985. Cell wall composition and rate of digestion of brown-midrib sorghum internodes as influenced by maturity. p. 953-954. In Proc. Int. Grassl. Congr. 15th. (Kyoto, Japan).
12. Volenec, J.J. 1985. Leaf area expansion and shoot elongation of diverse alfalfa germplasms. Crop Sci. 25:822-827.
13. Cherney, J.H., J.J. Volenec, and W.E. Nyquist. 1985. Sequential fiber analysis of forage as influenced by sample weight. Crop Sci. 25:1113-1115.
14. Volenec, J.J., J.H. Cherney, and K.J. Moore. 1986. Rate of synthesis of cell wall components in sorghum leaf blades. Crop Sci. 26:307-311.
15. Volenec, J.J. 1986. Nonstructural carbohydrates in stem base components of tall fescue during regrowth. Crop Sci. 26:122-127.
16. Cherney, J.H., K.J. Moore, J.J. Volenec, and J.D. Axtell. 1986. Rate and extent of digestion of cell wall components of brown-midrib sorghum species. Crop Sci. 26:1055-1059.
17. Volenec, J.J., J.H. Cherney, and K.D. Johnson. 1987. Yield components, plant morphology, and forage quality of alfalfa as influenced by plant population. Crop Sci. 27:321-326.
18. Cherney, J.H., K.D. Johnson, J.E. Tuite and J.J. Volenec. 1987. Microfloral and compositional changes in alfalfa hay stored at different moisture contents. Anim. Feed Sci. Technol. 17:45-56.
19. Knapp, J.S., C.L. Harms, and J.J. Volenec. 1987. Growth regulator effects on wheat culm nonstructural and structural carbohydrates and lignin. Crop Sci. 27:1201-1205.
20. Twidwell, E.K., K.D. Johnson, J.H. Cherney, and J.J. Volenec. 1988. Forage quality and digestion kinetics of switchgrass herbage and morphological components. Crop Sci. 28:778-782.
21. Volenec, J.J. 1988. Herbage growth and carbohydrate metabolism of diploid and tetraploid alfalfa. Crop Sci. 28:128-132.
22. Etzel, M.G., J.J. Volenec, and J.J. Vorst. 1988. Leaf morphology, shoot growth, and gas exchange of multifoliolate alfalfa phenotypes. Crop Sci. 28:263-269.
23. Housley, T.L., and J.J. Volenec. 1988. Fructan content and synthesis in leaf tissues of tall fescue. Plant Physiol. 86:1247-1251.
24. MacAdam, J.W., J.J. Volenec, and C.J. Nelson. 1989. Effects of nitrogen on mesophyll cell division and epidermal cell elongation in tall fescue leaf blades. Plant Physiol. 89:549-556.

25. Fankhauser, Jr., J.J. and J.J. Volenec. 1989. Root vs. shoot effects on herbage regrowth and carbohydrate metabolism of alfalfa. Crop Sci. 29:735-740.
26. Cherney, J.H., J.J. Volenec, and G.A. Brown. 1989. Synthesis of cell wall components in maize internodes. In Proc. Int. Grassl. Congr., 16th. (Nice, France).
27. Cherney, J.H., K.D. Johnson, J.J. Volenec, and K.S. Anliker. 1989. Chemical composition of herbaceous grass and legume species. Biomass 17:215-238.
28. Fankhauser, Jr., J.J., J.J. Volenec, and G.A. Brown. 1989. Composition and structure of starch from taproots of contrasting genotypes of *Medicago sativa* L. Plant Physiol. 90:1189-1194.
29. Hendershot, K.L., and J.J. Volenec. 1989. Shoot growth, dark respiration, and nonstructural carbohydrates in contrasting alfalfa genotypes. Crop Sci. 29:1271-1275.
30. Brown, G.A., and J.J. Volenec. 1989. Isolation and molecular composition of starch from roots of *Medicago sativa* L. Starch 41:247-250.
31. Volenec, J.J., and J.H. Cherney. 1990. Yield components, morphology, and forage quality of multifoliolate alfalfa phenotypes. Crop Sci. 30:1234-1238.
32. Habben, J.E., and J.J. Volenec. 1990. Starch grain distribution in taproots of defoliated *Medicago sativa* L. Plant Physiol. 94:1056-1061.
33. Volenec, J.J., P.J. Boyce, and K.L. Hendershot. 1991. Carbohydrate metabolism in taproots of *Medicago sativa* L. during winter adaptation and spring regrowth. Plant Physiol. 96:786-793.
34. Cherney, J.H., K.D. Johnson, J.J. Volenec, and D.K. Greene. 1991. Biomass potential of selected grass and legume crops. Energy Sources. 13:283-292.
35. Wood, K.V., K.J. Stringham, D.L. Smith, J. J. Volenec, K.L. Hendershot, K.A. Jackson, P.J. Rich, W-J. Yang, and D. Rhodes. 1991. Betaines of alfalfa. Plant Physiol. 96:892-897.
36. Habben, J.E., and J.J. Volenec. 1991. Amylolytic activity in taproots of diploid and tetraploid *Medicago sativa* L. Ann. Bot. 68:393-400.
37. Boyce, P.J., and J.J. Volenec. 1992. Purification and partial characterization of β-amylase from alfalfa taproots. Phytochem. 31:427-431.
38. Cherney, D.J.R., J.J. Volenec, and J.H. Cherney. 1992. Protein solubility and degradation as influenced by buffer and maturity of alfalfa. Animal Sci. Feed Technol. 37:9-20.
39. Boyce, P.J., and J.J. Volenec. 1992. Taproot carbohydrate concentrations and stress tolerance of alfalfa. Crop Sci. 32:757-761.
40. Boyce, P.J., E. Penaloza, and J.J. Volenec. 1992. Amylase activity in taproots of *Medicago sativa* L. and *Lotus corniculatus* L. following defoliation. J. Exp. Bot. 43:1053-1059.
41. Cherney, J.H., and J.J. Volenec. 1992. Forage evaluation as influenced by environmental replication (Review article). Crop Sci. 32:841-846.
42. Hendershot, K.L., and J.J. Volenec. 1993. Taproot nitrogen accumulation and use in overwintering alfalfa (*Medicago sativa* L.). J. Plant Physiol. 141:68-74.
43. Cherney, D.J.R., J.H. Cherney, and J.J. Volenec. 1993. Inhibition of structural carbohydrate fermentation by cellulase filtrates of alfalfa. J. Appl. Anim. Res.3:19-30.
44. Hendershot, K.L., and J.J. Volenec. 1993. Nitrogen pools in taproots of *Medicago sativa* L. after defoliation. J. Plant Physiol. 141:129-135.
45. Ashworth, E.N., V.E. Stirm, and J.J. Volenec. 1993. Seasonal variation in soluble sugars and starch within woody stems of *Cornus sericea* L. Tree Physiol. 13:379-388.

46. Nichols, M.B., M-O. Bancal, M.E. Foley and J.J. Volenec. 1993. Nonstructural carbohydrates in dormant and afterripened wild oat caryopses. Physiol. Plant. 88:221-228.
47. Beuselinck, P.R., J.H. Bouton, W.O. Lamp, A.G. Matches, M.H. McCaslin, C.J. Nelson, L.H. Rhodes, C.C. Sheaffer, and J.J. Volenec. 1994. Improving legume persistence in forage crop systems. J. Prod. Agric. 7:311-322. [A review, authors listed alphabetically].
48. Volenec, J.J., and S.M. Cunningham. 1995. Effect of applied nitrogen on seedling growth and cotyledon protein utilization of effective and ineffective nodulating alfalfa. J. Plant Nutr. 18:1519-1534.
49. Cunningham, S.M., and J.J. Volenec. 1996. Purification and characterization of vegetative storage proteins from alfalfa (*Medicago sativa* L.) taproots. J. Plant Physiol. 147:625-632.
50. Li, R., J.J. Volenec, B.C. Joern, and S.M. Cunningham. 1996. Seasonal changes in nonstructural carbohydrates, protein, and macronutrients in roots of alfalfa, red clover, sweetclover, and birdsfoot trefoil. Crop Sci. 36:617-623.
51. Volenec, J.J., A. Ourry, and B.C. Joern. 1996. A role for nitrogen reserves in forage regrowth and stress tolerance. Physiol. Plant. 97:185-193.
52. Avice, J-C., A. Ourry, J.J. Volenec, G. Lemaire, and J. Boucaud. 1996. Defoliation-induced changes in abundance and immuno-localization of vegetative storage proteins in taproots of *Medicago sativa*. Plant Physiol. Biochem. 34:561-570.
53. Barber, L.D., B.C. Joern, J.J. Volenec, and S.M. Cunningham. 1996. Supplemental nitrogen effects on alfalfa regrowth and nitrogen mobilization from roots. Crop Sci. 36:1217-1223.
54. Li, R., J.J. Volenec, B.C. Joern, and S.M. Cunningham. 1997. Effects of potassium and nitrogen nutrition on carbohydrate and protein metabolism in alfalfa roots. J. Plant Nutrition 20:511-529.
55. Kalengamaliro, N.E., J.J. Volenec, B.C. Joern, and S.M. Cunningham. 1997. Seedling development and deposition of starch and storage proteins in alfalfa roots. Crop Sci. 37:1194-1200.
56. Avice, J.C., A. Ourry, G. Lemaire, J.J. Volenec, and J. Boucaud. 1997. Root protein and vegetative storage protein are key organic nutritents for alfalfa shoot regrowth. Crop Sci. 37:1187-1193.
57. Gallagher, J.A., J.J. Volenec, L.B. Turner, and C.J. Pollock. 1997. Patterns of hydrolytic enzyme activities following defoliation of white clover (*Trifolium repens* L.). Crop Sci. 37:1812-1818.
58. Li, R., J.J. Volenec, B.C. Joern, and S.M. Cunningham. 1998. Effects of phosphorus nutrition on carbohydrate and protein metabolism in alfalfa roots. J. Plant Nutrition 21:459-474.
59. Cunningham, S.M., J.J. Volenec, and L.R. Teuber. 1998. Plant survival and root and bud composition of alfalfa populations selected for contrasting fall dormancy. Crop Sci. 38:962-969.
60. Gana, J.A., N.E. Kalengamaliro, S.M. Cunningham, and J.J. Volenec. 1998. Expression of an alfalfa β-amylase gene. Plant Physiol. 118:1495-1505.
61. Cunningham, S.M., and J.J. Volenec. 1998. Seasonal carbohydrate and protein metabolism in roots of contrasting alfalfa (*Medicago sativa* L.) cultivars. J. Plant Physiol. 153:220-225.

62. Kalengamaliro, N.E., J.A. Gana, S.M. Cunningham, and J.J. Volenec. 2000. Mechanisms regulating differential freezing tolerance of suspension cell cultures derived from contrasting alfalfa genotypes. Plant Cell Tiss. Organ Culture 61:143-151.
63. Noquet, C., J.C. Avice, A. Ourry, J.J. Volenec, S.M. Cunningham and J. Boucaud. 2001. Effects of environmental factors and endogenous signals on N uptake, N partitioning and taproot vegetative storage protein accumulation in *Medicago sativa*. Aust. J. Plant Physiol. 28:279-288.
64. Cunningham, S.M., J.A. Gana, J.J. Volenec, and L.R. Teuber. 2001. Winter hardiness, root physiology, and gene expression in successive fall dormancy selections from 'Mesilla' and 'CUF 101' alfalfa. Crop Sci. 41:1091-1098.
65. Shibli, R.A., D.M. Haagenson, S.M. Cunningham, W.K. Berg, and J.J. Volenec. 2001. Cryopreservation of alfalfa (*Medicago sativa* L.) cells by encapsulation-dehydration. Plant Cell Rpt. 20:445-450.
66. Justes, E., P. Thiebeau, J-C. Avice, G. Lemaire, J.J. Volenec, and A. Ourry. 2002. Influence of summer sowing dates, N fertilization and irrigation on autumn VSP accumulation and dynamics of spring regrowth in alfalfa (*Medicago sativa* L.). J. Exp. Bot. 53:111-121.
67. Volenec, J.J., S.M. Cunningham, D.M. Haagenson, W.K. Berg, B.C. Joern, and D.W. Wiersma. 2002. Physiological genetics of alfalfa improvement: past failures and future prospects. Field Crops Res. 75:97-110.
68. Haagenson, D.M., S.M. Cunningham, B.C. Joern and J.J. Volenec. 2003. Autumn defoliation effects on alfalfa winter survival, root physiology, and gene expression. Crop Sci. 43:1340-1348.
69. Cunningham, S.M., P. Nadeau, Y. Castonguay, S. Leberge and J.J. Volenec. 2003. Raffinose and stachyose accumulation, galactinol synthase expression, and winter injury of contrasting *Medicago sativa* germplasms. Crop Sci. 43:562-570.
70. Haagenson, D.M., S.M. Cunningham and J.J. Volenec. 2003. Root physiology of less fall dormant, winter hardy alfalfa selections. Crop Sci. 43:1441-1447.
71. Kalengamaliro, N.E., S.M. Cunningham and J.J. Volenec. 2003. Growth, sugar accumulation, and dark respiration of suspension cell cultures derived from contrasting alfalfa cultivars. Plant Cell Tiss. Organ Cult. 72:163-171.
72. Meuriot, F., J.-C. Avice, M.-L. Decau, J.-C. Simon, P. Laine, J.J. Volenec, and A. Ourry. 2003. Accumulation of N reserves and vegetative storage protein (VSP) in taproots of non-nodulated alfalfa (*Medicago sativa* L.) are affected by mineral N availability. Plant Sci. 165:709-718.
73. Noquet, C., F. Meuriot, J.-C. Avice, A. Ourry, S.M. Cunningham, and J.J. Volenec. 2003. Short-day photoperiod induced changes in N uptake, N partitioning and accumulation of vegetative storage proteins in two *Medicago sativa* L. cultivars. Func. Plant Biol. 30:853-863.
74. Avice, J-C., F. Le-Dily, E. Goulas, C. Noquet, F. Meuriot, J.J. Volenec, S.M. Cunningham, T.G. Sors, C. Dhont, Y. Castonguay, P. Nadeau, G. Belanger, F-P. Chalifour, and A. Ourry. 2004. Vegetative storage proteins in overwintering storage organs of forage legumes: roles and regulation. Can. J. Bot. 81:1198-1212.
75. Meuriot, F., C. Noquet, J.C. Avice, J.J. Volenec, S.M. Cunningham, T. Sors, S. Caillot, and A. Ourry. 2004. Methyl jasmonate alters N partitioning, N reserves accumulation and induces gene expression of a 32-kDa vegetative storage protein that possess chitinase activity in *Medicago sativa* L. taproots. Physiologia Plant. 120:113-123.

76. Zhai, T., R.H. Mohtar, F. El-Awar, W. Jabre, J.J. Volenec. 2004. Parameter estimation for process-based crop growth models. Trans ASAE 47:2109-2119.
77. Berg, W.K., S.M. Cunningham, S.M. Brouder, K.D. Johnson, B.C. Joern, and J.J. Volenec. 2005. Influence of phosphorus and potassium fertilization on alfalfa yield and yield components. Crop Sci. 45: 297-304.
78. Meuriot, F., M.-L. Decau, A. Morvan-Bertrand, M.-P. Prud'homme, F. Gastal, J.-C. Simon, J.J. Volenec, and J.-C. Avice. 2005. Contribution of initial C and N reserves in *Medicago sativa* recovering from defoliation: impact of cutting height and residual leaf area. Func. Plant Biol. 32:321-334.
79. Abu Qamar, S.F., T.G. Sors, S.M. Cunningham, B.C. Joern, and J.J. Volenec. 2005. Phosphate nutrition effects on growth, phosphate transporter transcript levels and physiology of alfalfa cells. Plant Cell Tiss. Organ Cult. 82:131-140.
80. Weishaar, M.A., E.C. Brummer, J.J. Volenec, K.J. Moore, and S.M. Cunningham. 2005. Improving winter hardiness in nondormant alfalfa germplasm. Crop Sci. 45:60-65.
81. Abu Qamar, S.F., S.M. Cunningham, and J.J. Volenec. 2006. Phosphate nutrition and defoliation effects on growth and root physiology of alfalfa. J. Plant Nutr. 29:1387-1403.
82. Castonguay, Y., S. Laberge, E.C. Brummer, and J.J. Volenec. 2006. Alfalfa winter hardiness: A research retrospective and integrated perspective. Adv. Agron. 90:203-265.
83. Berg, W.K., S.M. Cunningham, S.M. Brouder, K.D. Johnson, B.C. Joern, and J.J. Volenec. 2007. The long-term impact of phosphorus and potassium fertilization on alfalfa yield and yield components. Crop Sci. 47:2198-2209.
84. Patton, A.J., J.J. Volenec, and Z.J. Reicher. 2007. Stolon growth and dry matter partitioning explain differences in zoysiagrass establishment rates. Crop Sci. 47:1237-1245.
85. Patton, A.J., S.M. Cunningham, J.J. Volenec, and Z.J. Reicher. 2007. Differences in freeze tolerance of zoysiagrasses. I. Role of Proteins. Crop Sci. 47:2162-2169.
86. Patton, A.J., S.M. Cunningham, J.J. Volenec, and Z.J. Reicher. 2007. Differences in freeze tolerance of zoysiagrasses. II. Carbohydrate and proline accumulation. Crop Sci. 47:1270-1281.
87. Berg, W.K., S.M. Cunningham, S.M. Brouder, B.C. Joern, K.D. Johnson, J.J. Volenec. 2007. Phosphorus and potassium effects on C and N reserves and gene expression in alfalfa roots. Crop Sci. (submitted).
88. Hannaway, D.B., C. Daly, M. Halbleib, D. James, C. West, J.J. Volenec, D. Chapman, X. Li, W. Cao, J. Shen, and S. Johnson. 2007. Tall fescue adaptation and suitability zones. *In*: Tall Fescue On-line Monograph, Amer. Soc. Agron., Madison, WI. URL: (submitted).
89. Fernández F.G., S.M. Brouder, C.A. Beyrouty, J.J. Volenec, and R. Hoyum. 2008. Assessment of plant available potassium for no-till, rainfed soybean. Soil Sci. Soc. Amer. J. (in press).
90. Brouder, S.M. and J.J. Volenec. Impact of climate change on crop nutrient and water use efficiencies. Physiologia Plantarum (submitted).

Invited Papers and Lectures

1. Nelson, C J., J.J. Volenec, K.M. Zarrough, and J.H. Coutts. 1982. Tall fescue physiology and yield potential. p. 6-27. In N. Gaborcik (ed.). Potential of tall fescue in Czechoslovakia. Proceedings of a conference held at the Grassland Research Institute, Banska, Bystrica, Czechoslovakia, 1982, 237 pp.

2. Volenec, J.J. 1986. Opportunities for manipulation of partitioning, crop growth and yield. p. 277-283. In Proc. Plant Growth Regul. Soc. of Amer. Aug. 3-6, St. Petersburg, FL.
3. Volenec, J.J., J.H. Cherney, and K.D. Johnson. 1988. Alfalfa yield potential—a component analysis. pp. 1-8. In Proc. 18th National Alfalfa Symposium. March 2-3, 1988, St. Joseph, MO.
4. Cherney, J.H., J. Lowenberg-DeBoer, K.D. Johnson, and J.J. Volenec. 1988. Evaluation of grasses and legumes as energy resources. In Energy from Wastes XII. Feb. 15-19, 1988. New Orleans, LA. Gas Research Institute. 35 pp.
5. Volenec, J.J. 1989. Genotypic variation in starch metabolism in alfalfa taproots. NCR-144/NCR-155 joint meeting. Oct. 29-31, 1989. West Lafayette, IN.
6. Volenec, J.J., J.H. Cherney, and K.D. Johnson. 1991. Performance of multifoliolate alfalfa. p. 34-40. In Proc. 15th WI Forage Prod. Use Symp. Jan. 22 to 23, Wisconsin Dells, WI.
7. Volenec, J.J. 1991. Taproots - Keys to alfalfa productivity and survival. p. 49-54. In Proc. 15th WI Forage Prod. Use Symp. Jan 22 to 23. Wisconsin Dells, WI.
8. Volenec, J.J. 1993. Root physiology and stress adaptation in perennial plants. Feb. 4 to 5, 1993. Plant Physiology Program, University of Florida, Gainesville, FL.
9. Volenec, J.J. 1993. Taproot physiology of perennial legumes. Oct. 5, 1993. Institute for Grassland and Environmental Research, Aberystwyth, UK.
10. Volenec, J.J. 1994. Root Biology: Beyond nutrient and water uptake. Jan. 6, 1994. Aberystwyth Cell Biology Program, Aberystwyth, Wales, UK.
11. Volenec, J.J. 1994. Taproot organic reserves and stress tolerance of alfalfa. Dec. 8, 1994. Univ. of CA-Davis.
12. Volenec, J.J., B.C. Joern, S.M. Cunningham, and A. Ourry. 1996. Root physiology and alfalfa persistence: myths, new paradigms, and future explorations. 35th North Amer. Alfalfa Improvement Conference. July 16-20, 1996. Oklahoma City, OK.
13. Volenec, J.J., B.C. Joern, A. Ourry, and S.M. Cunningham. 1996. Molecular analysis of alfalfa root vegetative storage proteins. American Soc. Agron. Ann. Meetings, Nov. 3 to 8, 1996. Indianapolis, IN.
14. Volenec, J.J., B.C. Joern, and S.M. Cunningham. 1996. Effects of potassium nutrition on carbohydrate and protein metabolism in alfalfa roots. American Soc. Agron. Ann. Meetings, Nov. 3 to 8, 1996. Indianapolis, IN.
15. Volenec, J.J., B.C. Joern, A. Ourry, and S.M. Cunningham. 1998. Molecular analysis of alfalfa root vegetative storage proteins. Ann Meeting of Amer. Soc. Agron.
16. Volenec, J.J., B.C. Joern, and S.M. Cunningham. 1998. Effects of potassium nutrition on carbohydrate and protein metabolism in alfalfa roots. Ann Meeting of Amer. Soc. Agron.
17. Volenec, J.J. 1998. Stress tolerance in perennial plants - the role of root organic reserves. Indiana University Biology Dept., March 3, 1998
18. Volenec, J.J. 1998. Future Directions in Forage Management. American Forage Grassland Council. March 8 to 10, 1998, Adams Mark Hotel, Indianapolis, IN.
19. Volenec, J.J. 1999. Physiological Mechanisms Controlling Alfalfa Stress Tolerance. Dept. of Plant and Soil Science, University of Maryland, College Park, MD. March 1, 1999.
20. Volenec, J.J. 1999. Mechanisms controlling alfalfa persistence. Crop Science Dept., The Ohio State University, May 13 to 14.
21. Volenec, J.J. 1999. Carbon and nitrogen metabolism in *Lotus*. International Botanical Congress, August 1 to 7. St. Louis, MO

22. Cunningham, S.M., J.A. Gana, and J.J. Volenec. 1999. Cold acclimation responsive genes from alfalfa. Gordon Research Conference, Jan. 31 to Feb. 4. Ventura, CA.
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158. Lissbrant, S., S.M. Brouder, B.C. Joern, S.M. Cunningham, and J.J. Volenec. 2007. Identification of P and K fertility regimes that enhance long-term productivity of alfalfa using cluster analysis. Joint Meeting of the Soc. Range Manage/Amer. Forage Grassl. Coun., Louisville, Kentucky, Jan 26-31, 2008. http://srm.confex.com/srm/2008/techprogram/P2058.HTM
159. Brouder, S.M., R.F. Turco, and J.J. Volenec. 2007. What we know about the influence of best management practices on nitrogen and dissolved organic carbon losses from agricultural fields in the Eastern Cornbelt. 4th Intern. Nitrogen Conference. Oct. 1 to 5, Costa do Sauipe-Bahia, Brazil.
160. Robinson, A.P., S.P. Conley, and J.J. Volenec. 2007. Impact of planting date on soybean seed composition, germination, and seedling vigor. Annu. Meeting Amer. Seed Trade Assoc. Dec. 4 to 6, 2007, Chicago, IL.

Contributions to GenBank

1. Gana, J.A., N.E. Kalengamaliro, S.M. Cunningham, and J.J. Volenec. 1997. Characterization and expression of a cDNA clone encoding beta-amylase from *Medicago sativa* roots. GenBank Accession AF026217.

2. Gana, J.A., S.M. Cunningham, and J.J. Volenec. 1998. A cDNA for a cold acclimation-responsive gene that is associated with alfalfa winter survival. GenBank Accession AF072932.
3. Gana, J.A., S.M. Cunningham, and J.J. Volenec. 1998. Characterization of a cDNA encoding a chlorophyll a/b binding protein from alfalfa buds. GenBank Accession AF072931.
4. Gana, J.A., S.M. Cunningham, and J.J. Volenec. 1999. A cDNA for a cold acclimation-responsive gene that is associated with alfalfa winter survival (BudCAR2). GenBank Accession AF180373.
5. Cunningham, S.M., J.A. Gana, and J.J. Volenec. 1999. Cold acclimation responsive protein BudCAR3. GenBank Accession AF220101.
6. Cunningham, S.M., J.A. Gana, and J.J. Volenec. 1999. Cold acclimation responsive cDNA from alfalfa crown buds, BudCAR4. GenBank Accession AF220456.
7. Cunningham, S.M., J.A. Gana, and J.J. Volenec. 1999. Cold acclimation responsive cDNA from alfalfa crown buds, BudCAR5. GenBank Accession AF220457.
8. Cunningham, S.M., J.A. Gana, and J.J. Volenec. 1999. Cold acclimation responsive cDNA from alfalfa crown buds, BudCAR6. GenBank Accession AF220458.
9. Sors T.G., S.M. Cunningham and J.J. Volenec. 2002. *Medicago sativa* high molecular weight vegetative storage protein, homology similar to type III endochitinase. GenBank Accession No. AF530579.
10. Cunningham, S.M., and J.J. Volenec. 2003. *Medicago sativa* putative ADP-ribosylation factor. GenBank Accession No. AY466444.

G. Grants Awarded (since 1995)

1. USDA Challenge Grant. Development of a National Forage Curriculum for the WWW. D.B. Hannaway, C.J. Nelson, J.J. Volenec, K.D. Johnson, G.D. Lacefield, J.M. Henning, C. Holland, R.F. Barnes, L. Brown, and M.A. Sanderson. 1995. $150,000.
2. USDA-NRI. Cold Acclimation Mechanisms in Contrasting Alfalfa Selections. J.J. Volenec.
3. USDA-NRI. Disruption of Phloem Translocation Induced by a Leafhopper: Interaction Between Feeding Injury and Plant Development. W.O. Lamp and J.J. Volenec.
4. Potash and Phosphate Institute. Phosphate Nutrition and Alfalfa Root Physiology. J.J. Volenec and B.C. Joern. 1995. $4,000.
5. Potash Corporation of Saskatchewan. Potassium Nutition and Alfalfa Root Physiology. J.J. Volenec and B.C. Joern. 1995. $2,000.
6. Purdue Research Foundation. Taproot Nitrogen Reserves and Shoot Nitrogen Nutrition of Alfalfa. J.J. Volenec. 1995. $20,400.
7. Potash and Phosphate Institute. Phosphate Nutrition and Alfalfa Root Physiology. J.J. Volenec and B.C. Joern. 1996. $2,000.
8. USDA NRI. Cold Acclimation Mechanisms in Contrasting Alfalfa Selections. J.J. Volenec. 1996. $155,772 (for 2 years).
9. NSF. Enhancing Plant Growth Facilities at Purdue University. W.R. Woodson, C. Chapple, C. Mitchell, J.A. Banks, and J.J. Volenec. 1997. $975,000.
10. Potash and Phosphate Institute. Phosphate Nutrition and Alfalfa Root Physiology. J.J. Volenec and B.C. Joern. 1997. $2,000.

11. Purdue Research Foundation. Biotechnical Approaches for Reducing Pollution from Swine Production in Indiana. J.J. Volenec, K.G. Raghothama, O. Adeola, and B.C. Joern, Team PRF Award. 1998. $72,000.
12. USDA-NRI. Plant Physiological Disruption Induced by a Sap Feeding Insect. W. Lamp, B. Quebedeaux, and J.J. Volenec. 1998. $150,000.
13. Purdue Research Foundation. Molecular Mechanisms Controlling Alfalfa Fall Dormancy and Winter Survival. J.J. Volenec. 1998. $11,666.
14. Council for International Exchange of Scholars. Physiological and Biochemical Aspects of Abiotic Stress Tolerance in Alfalfa Cells. Fullbright Fellowship for Dr. Rida Shibli. R. Shibli and J.J. Volenec. 1999. $26,000.
15. Foundation for Agronomic Research. Potassium and Phosphorus Research on Alfalfa. J.J. Volenec, B.C. Joern, S.M. Brouder, and K.D. Johnson. 1999. $6,000.
16. Purdue Research Foundation. Molecular Analysis of Crown Bud Development in Defoliated Alfalfa. J.J. Volenec. 2000. $24,000.
17. Foundation for Agronomic Research. Potassium and Phosphorus Research on Alfalfa. J.J. Volenec, B.C. Joern, S.M. Brouder and K.D. Johnson. 2000. $3,000.
18. IMC. Alfalfa P and K Nutrition. J.J. Volenec, B.C. Joern, S.M. Brouder and K.D. Johnson. 2000. $5,000.
19. USDA-IFAFS Program. A Multifaceted Approach to Understand the Genetic Basis of Winter Hardiness in Alfalfa. E.C. Brummer, J.J. Volenec, M.P. Scott, K.J. Moore, and D. Luth. 2000. $549,816.
20. University of Maryland. Plant Physiological Disruption Induced by a Sap-feeding Insect. J.J. Volenec. 2000. $31,949.
21. Foundation for Agronomic Research. Potassium and Phosphorus Research on Alfalfa. J.J. Volenec, B.C. Joern, S.M. Brouder and K.D. Johnson. 2001. $3,000.
22. Agricultural Research Programs of Purdue University, Rice Fund Grant. Soil Test Phosphorus (P) and Potassium (K) and Alfalfa Productivity. J.J. Volenec and B.C. Joern. 2001. $10,000.
23. Purdue Research Foundation. Molecular Analysis of Crown Bud Development in Defoliated Alfalfa. J.J. Volenec. 2001. $13,134.
24. Iowa State University. The Genetic Basis of Alfalfa Winter Hardiness. J.J. Volenec. 2001. $184,961.
25. NASA NSCORT Space Life. Minimizing equivalent Systems Mass for a Regenerative Life Support System by Optimizing Kinetics and Energenetics of Major Biotransformations. J.J. Volenec, M.K. Banks, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, P.B. Brown, A.J. Heber, M.R. Ladisch. 2002. $1,600,000.
26. Pioneer Hi-Bred International Crop Managament Research Award. Does Chilling Injury Contribute to Arrested Ear Development in Maize? J.J. Vorst, J.J. Volenec and R.L. Nielsen. 2002. $8000.
27. Foundation for Agronomic Research. Potassium and Phosphorus Research on Alfalfa Growth, Yield, and Root Physiology. J.J. Volenec. 2002. $4,500.
28. IMC Global. Potassium and Phosphorus Effects on Alfalfa Yield Components, Root Physiology, and Tissue Analysis. J.J. Volenec. 2002. $2,500.
29. Foundation for Agronomic Research. Phosphate and Potassium Management for Alfalfa. J.J. Volenec. 2002. $2,500.
30. IMC and PCS Sales. Graduate Fellowship in Potassium Research. J.J. Volenec, K Team. 2002. $120,000.

31. Mary S. Rice Fund. Soil P x K Interactions Determine Alfalfa Yield and Persistence, and Alter Root Physiology. J.J. Volenec. 2003. $7,500.
32. Foundation for Agronomic Research. FDN for Agronomic Research Potash and Phosphate Inst. J.J. Volenec. 2003. $5,000.
33. Foundation for Agronomic Research. FDN for Agronomic Research Potash and Phosphate Inst. J.J. Volenec. 2004. $3,000.
34. National Aeronautics and Space Administration. Minimizig Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, P.B. Brown, A.J. Heber, M.R. Ladisch. 2004. $2,000,000.
35. Purdue Research Foundation: XR Grant. Discovery and Chracterization of Taproot Genes Controlling Alfalfa Survival. J.J. Volenec. 2004. $14,715.
36. Foundation for Agronomic Research. FDN for Agronomic Research Potash and Phosphate Inst. J.J. Volenec. 2005. $2,500.
37. Foundation for Agronomic Research. FDN for Agronomic Research Potash and Phosphate Inst. J.J. Volenec. 2005. $4,000.
38. National Aeronautics and Space Administration. Minimizing Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, R.H. Arangarasan, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, P.B. Brown, A.J. Heber, S. Orcun, M.R. Ladisch. 2005. $408,462.
39. National Aeronautics and Space Administration. Minimizing Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, R.H. Arangarasan, R.F. Turco, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, P.B. Brown, A.J. Heber, S. Orcun, M.R. Ladisch. 2005. $24,000.
40. National Aeronautics and Space Administration. Minimizing Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, P.B. Brown, A.J. Heber, M.R. Ladisch. 2005. $500,000.
41. National Aeronautics and Space Administration. Minimizing Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, P.B. Brown, A.J. Heber, M.R. Ladisch. 2005. $1,000,000.
42. National Aeronautics and Space Administration. Minimizing Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, R.H. Arangarasan, R.F. Turco, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, P.B. Brown, A.J. Heber, S. Orcun, M.R. Ladisch. 2005. $150,800.

43. Mary S. Rice Farm Estate. P & K Soil Testing: Effects of Year, Within Year Variation, and Sampling Depth on Alfalfa Productivity and Nutrient Recovery. B.C. Joern, S.M. Brouder and J.J. Volenec. 2005. $7,000.
44. Foundation for Agronomic Research. Foundation for Agronomic Research. J.J. Volenec. 2005. $1,000.
45. Pennsylvania State University. Development of Interactive, Computer-based Teaching Modules for Undergraduate Forages Courses. J.J. Volenec. 2005. $37,597.
46. Purdue Research Foundation: XR Grant. Discovery and Chracterization of Taproot Genes Controlling Alfalfa Survival. J.J. Volenec. 2005. $14,912.
47. National Aeronautics and Space Administration. Minimizig Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, R.H. Arangarasan, R.F. Turco, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, J.F. Russell, P.B. Brown, A.J. Heber, S. Orcun, M.R. Ladisch. 2006. $91,538.
48. National Aeronautics and Space Administration. Minimizig Equivalent System Mass for a Regenerative Life-Support System by Optimizing Kinetics and Energetics of Major Bio-Transformations. J.J. Volenec, M.K. Banks, G.S. Gardner, J.E. Alleman, W.R.Woodson, B.M. Applegate, B. Yao, C.A. Mitchell, E.R. Blatchley, J.H. Allen, R.H. Arangarasan, R.F. Turco, G.T. Chiu, J.F. Pekny, B.C. Joern, L.J. Mauer, Y. Yih, J.F. Russell, P.B. Brown, A.J. Heber, S. Orcun, M.R. Ladisch. 2006. $1,664,673.
49. USDA-CSREES Higher Education Challenge Grant. Development of Interactive, Computer-Based Teaching Modules for Undergraduate Forage Courses. M. Hall, J.J. Volenec. R. Leep, C.C. Sheaffer, K.J. Moore, M Wiendenhoeft, K. Albrecht, B. Kojis, and R. Radhakrishna. The Pennsylvania State University, Purdue University, Michigan State University, Iowa State University, University of Minnesota, and the University of Wisconsin. October 1, 2006 to September 30, 2008. $400,000.
50. Purdue University College of Agriculture, Agricultural Research Program Mission-oriented Grants Program. Impact of Potassium and Phosphorus Nutrition on Establishment and Early Growth of Switchgrass Used for Biofuels. J.J. Volenec, S.M. Brouder, K.D. Johnson, and B.C. Joern. 2007. $25,000.

H. Statement of Research Contribution

Dr. Volenec conducts research on physiological processes that influence productivity of perennial forage crops. Two processes of particular importance in these crops are their ability to overwinter, and to withstand complete defoliation at monthly intervals during the growing season. By understanding the biochemical and physiological mechanisms by which forages tolerate these severe stresses, Dr. Volenec hopes to be able to design rational and efficient approaches to improve their productivity and long-term persistence.

Root physiology of forage legumes is a primary focus of Dr. Volenec's research. Starch accumulates to concentrations that exceed 35% of dry weight in the large carrot-like taproots found in these species. Studies by Volenec and his students were the first to show that high levels of root starch do not necessarily lead to rapid regrowth after defoliation of alfalfa. Genotypes with as little as 5% starch in their taproots regrow as fast or faster than comparable high-starch genotypes after harvest. Subsequent work indicated that the activity of certain starch-degrading enzymes (α-amylases) rather than the quantity of starch has the greatest impact on rate of shoot regeneration

following defoliation. Volenec's work showed that varieties lacking one isoform of α-amylase in roots degraded little of their taproot starch after defoliation and also had very slow shoot regrowth. The elite, high yielding alfalfa cultivars that have been monitored have high concentrations of this particular amylase. Volenec and co-workers are developing molecular probes that will facilitate rapid screening of alfalfa germplasms to identify those that possess this important plant attribute.

Because inhibition of nitrogen fixation may limit productivity of forage legumes in spring when soils are cold and after defoliation, other studies explore the role of taproot proteins in mediating regrowth and persistence of alfalfa. Volenec and his students have shown that a large decline in taproot protein concentration occurs after harvest and during initial growth in the spring. More importantly, they have discovered three proteins that may comprise as much as 50% of the pool of soluble proteins in taproots and these are preferentially degraded during taproot protein utilization. These proteins are considered to be vegetative storage proteins (VSP's). Working with mutants lacking these VSP's, Volenec has shown that regrowth rate of -VSP plants is less half that of their +VSP counterparts following defoliation. Studies are underway to elucidate the mechanisms involved in the synthesis and degradation of taproot VSP's. This information will facilitate genetic improvement of alfalfa, and possibly other forage legume species in a rational, well-defined manner.

Fall dormancy reaction is another topic receiving emphasis in Volenec's research program. It has been recognized for some time that alfalfas with reduced vegetative growth in autumn are more winter hardy than cultivars that continue shoot growth late into fall. Decreasing photoperiods and lower temperatures during fall produce morphological types not readily seen in spring or summer. Nondormant cultivars (Dormancy Groups 7, 8, and 9) adapted to equatorial latitudes are distinguished from dormant cultivars by their erect shoot growth in fall. In contrast, dormant cultivars (Dormancy Groups 1, 2, and 3) produce short shoots in fall that grow prostrate along the soil surface. Cultivars of intermediate dormancy also exist. Our understanding of the biological mechanisms underlying fall dormancy is virtually nonexistent. This is despite the fact that, more than any other single feature, fall dormancy is used to predict alfalfa adaptation. The goal of this research is to identify and understand the nature of genes and gene products essential for winter hardiness of alfalfa. Volenec's work is unique in that it uses alfalfa germplasms that differ in fall growth habit and winter hardiness, but which are otherwise closely related. This approach will enable Volenec and his associates to identify key differences that retain the positive attribute of good shoot growth in late summer and fall, while simultaneously improving winter hardiness. Ultimately, higher yielding, more winter hardy alfalfa varieties will be developed. These improved varieties will reduce alfalfa production costs for farmers, and food costs to consumers.

Proper potassium (K) and phosphorus (P) nutrition is critical for high forage yield and plant persistence of alfalfa (Medicago sativa L.). Volenec and his students are evaluating how P and K influenced agronomic performance by analyzing yield components. The results of a long-term field study reveal that high forage yield is always positively associated greater individual shoot mass. As the stand aged and plant population densities declined, a positive influence of shoots per area also was observed in poorly fertilized plots. Improved plant persistence occurred in K-fertilized plots, while fertilization with P without addition of K fertilizer reduced plant populations and yield. Application of P increased taproot amino acid concentrations, but decreased taproot starch levels whereas K increased sugars, but decreased taproot protein concentrations. Phosphorus fertilization decreased transcript abundance for the high molecular weight vegetative storage protein (VSP), while addition of K increased VSP transcripts. These findings will result in improved diagnostic tools (soil tests,

tissue tests) that will be helpful in managing P and K for improved agronomic performance of alfalfa while protecting the environment.

I. Professional Contributions to Teaching

Courses Taught

Agronomy 525, *Crop Physiology and Ecology* (3 hrs.) 1984-2007, 807 students
Dr. Volenec has developed Agronomy 525, Crop Physiology and Ecology, to provide advanced undergraduate and graduate students with an introductory course in crop physiology. It is intended to expand knowledge acquired in plant physiology and biochemistry courses to cover challenges encountered in management and genetic improvement of crops. Extensive web resources are used to supplement course content using WebCT.

Agronomy 505, *Forage Management* (3 hrs.) 1991-2007, 341 students
Dr. Volenec assumed responsibility for Agronomy 505, Forage Management, in 1991. This course serves a diverse clientele of animal scientists, agronomists, and ag. economists at both the graduate and undergraduate levels. Dr. Volenec's goal is to provide these students with a sound understanding of the principles underlying decisions that influence yield, quality and persistence of forage species. Volenec co-authored two chapters to the text used in Agronomy 505 when it was recently revised. He also contributed to a CD-ROM companion for the text which contains more than 1000 supplementary images and photos for class use. As with AGRY 525, Volenec uses several web resources to enhance student learning.

Other Teaching Activities

Dr. Volenec is committed to educating students outside of the traditional classroom setting. Each summer Dr. Volenec has obtained support that enables him to bring high school juniors or seniors into his research laboratory for eight to ten weeks. He has also had two high school science teachers conduct plant science research in his laboratory twice for eight week sessions. The goal of these programs is to allow excellent students and progressive science teachers to explore plant science research in a University setting.

J. Professional Contributions in Administration.

In 1991, Volenec was asked to serve as Assistant Head in the Department of Agronomy. In this capacity he has assisted with innumerable projects like designing and implementing a $12 million dollar renovation of all departmental facilities including offices, classrooms, laboratories, and greenhouses. In the absence of the Department Head, he serves as the liaison between the Department of Agronomy and other Departments on campus, as well as the public. Volenec has served the tri-societies in several capacities including the CSSA Board of Directors, Fellows Committees, Monograph Committee, and in several capacities for Crop Science including Editor, and most recently Editor-in-Chief.

K. Professional Contributions in Outreach and Technology Transfer.

Volenec has a small (10%) extension education appointment. In this capacity he answers producer questions pertaining to forage-livestock production. He also annually participates in several major forage field day events coordinated by Dr. Keith Johnson, the Forage Extension Specialist for

Purdue University. Volenec also is a member of the Alfalfa Crop Advisory Committee for USDA. This group is comprised of alfalfa scientists from USDA, public universities, and the private sector, and is responsible for acquiring, evaluating, and enhancing alfalfa germplasms from around the world. As an alfalfa physiologist, Volenec plays an important role in framing discussions focused on alfalfa evaluation and enhancement. The Indiana Forage Council recognized and awarded Volenec its Merit Award in 1991. In recognition of his outstanding service to grassland agriculture in the US, Volenec also received the Merit award from the American Forage and Grassland Council in 1998. Such honors are rare for researchers whose programs possess such a fundamental focus as does Volenec's; an observation that speaks to his willingness and ability to apply basic concepts to crop improvement in a meaningful manner.