Yield Component Analysis and Selection Criteria for Long-term Productivity of Alfalfa.

Jeffrey J. Volenec, W. Kess Berg, Suzanne M. Cunningham, Brad C. Joern, Sylvie M. Brouder, and Keith D. Johnson.
Department of Agronomy, Purdue University, 915 West State St., West Lafayette, IN 47907-2054. (jvolenec@purdue.edu)

Component analysis of alfalfa (*Medicago sativa* L.) forage yield can reveal how plant density, shoot density, and shoot mass interact and affect herbage production. Critical shoot density values of 440 to 590 shoots m^{-2} (40 to 55 shoots ft^{-2}) have been proposed as a minimum density for productive alfalfa stands recently. Our objective was to determine relationships among shoot density, mass per shoot, and forage yield of alfalfa as influenced by P and K fertilizer application. Mass per shoot was closely associated with herbage yield at each harvest of every year, whereas the relationship of shoot density to forage yield varied both with year and harvest within year. From 1998 to 2001, there was generally no relationship or a negative linear relationship between forage yield and shoot density over a range 350 to 800 shoots m^{-2}. Beginning with Harvest 2 of 2002 a positive linear relationship between shoot density and forage yield was often observed. Poor fertility management reduced shoots/m^{-2} and with it, forage yield. To better define the relative contribution of each yield component, path analysis (yield=shoots m^{-2} x mass $shoot^{-1}$) was performed at all harvests. The ratio of the path coefficient for mass $shoot^{-1}$ to that of shoots m^{-2} was calculated (Table 1). A ratio greater than one indicates that mass $shoot^{-1}$ was more important than shoots m^{-2} in determining forage yield at that harvest. At 13 of 16 forage harvests (except Harv. 2 of 2003 and Harv. 3 and 4 of 2004) the ratios of path coefficients of mass $shoot^{-1}$ and shoots m^{-2} exceeded 1 indicating a greater impact of mass $shoot^{-1}$ on yield. At Harv. 3 and 4 of 2004 a ratio of 0.9 and 1 indicates that these yield components were of equal importance in determining yield. Both regression and path analysis revealed that improved forage yield was consistently associated with greater mass $shoot^{-1}$. Because fertilizer responsiveness is closely associated with greater mass $shoot^{-1}$, cultivars with the genetic capacity for high shoot mass may possess a greater yield potential, and be more responsive to P and K fertilizer application.

Table 1. Ratio of path coefficients for mass $shoot^{-1}$:shoots m^{-2} from 2001 to 2004. A ratio of 1 indicates equal importance of these components in determining yield at that harvest.

Year	Harvest 1	Harvest 2	Harvest 3	Harvest 4
2001	13:1	57:1	1.4:1	4.5:1
2002	4.7:1	1.8:1	1.4:1	1.7:1
2003	2.4:1	0.3:1	1.4:1	1.6:
2004	2.2:1	1.2:1	1:1	0.9:1

References

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.

Berg, W.K., S.M. Cunningham, S.M. Brouder, K.D. Johnson, B.C. Joern, and J.J. Volenec. 2006. The long-term impact of phosphorus and potassium fertilization on alfalfa yield and yield components. Crop Sci. (submitted)