

Predicted efficiency of indirect selection to increase tall fescue forage mass in a grass-alfalfa mixture

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High fertilizer prices and emphasis on environmental stewardship have increased interest in grass-legume mixed pastures. It has been hypothesized that compatibility of grasses and legumes, or their 'ecological combining ability', can be improved by breeding specifically for mixture performance. However, this is in the proof of concept stage and it is not known if there is variation for ecological combining ability, or if it is under different genetic control than performance in monoculture. This experiment studied the predicted efficiency of a grass monoculture (intra-specific competition) to indirectly select for increased tall fescue (*Festuca arundinacea* Schreb.) forage mass in a grass-legume mixture (inter-specific competition). Narrow-sense heritabilities, genetic and rank correlations, and indirect selection efficiencies were estimated for forage mass in a tall fescue population (45 half-sib families) grown as spaced plants overseeded with either turf-type tall fescue (monoculture) or alfalfa (mixture). Heritabilities for tall fescue forage mass were 0.63, 0.53, 0.47, 0.32, and 0.70 in monoculture; and 0.43, 0.27, 0.47, 0.29, and 0.55 in mixture for successive harvests in June, July, August, October, and seasonal total, respectively. Genetic correlation between tall fescue forage mass in monoculture and mixture varied, with values of 0.48, 0.92, -0.31, 0.70, and 0.25 for harvests in June, July, August, October, and seasonal total, respectively. The higher heritabilities in monoculture, as compared to mixture for the June, July, and October harvests, combined with moderate to high genetic correlations, resulted in predicted indirect selection efficiencies approaching or exceeding direct selection for mixtures for these harvests (0.70, 1.82, and 0.77, respectively). Whereas, indirect selection efficiency was low for the August harvest and the seasonal total forage mass (-0.32 and 0.31, respectively). Moreover, overall low Spearman's rank correlations (-0.03 to 0.35) indicated differing half-sib family performance between the monoculture and mixture environments. Overall, mostly indirect selection efficiencies of less than '1', and low rank correlations, indicate that direct selection with inter-specific competition will more effectively increase tall fescue forage mass in a grass-alfalfa mixture. Overall, these data support the hypothesis that ecological combining ability can be improved by breeding specifically for grass-legume mixture performance.