Genetic structure and agronomic value of Italian alfalfa landraces: a synopsis

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Italian landraces of alfalfa evolved across centuries of cultivation and were a major share of the Italian seed market until their ban to commercialization in 2002. Information on the extent of among- and within-population genetic variation, the agronomic value and the extent of specific-adaptation effects is indispensable for efficient exploitation of landrace genetic resources. This work summarizes the indications from various studies on the genetic structure and the agronomic value of alfalfa landraces from northern Italy relative to germplasm of locally-adapted varieties. Each of the seven former commercial ecotypes of this region was represented by at least one farm landrace. The studies included 11 to 13 landraces and 4 to 7 locally-adapted varieties grown in density under field conditions or in four artificial environments combining two soil types by two levels of summer drought.

On average, landrace germplasm was at least as performing as variety germplasm for forage yield and persistence over two or three years (Table 1). Landraces exhibited specific adaptation towards summer drought-stress levels similar to those of their environment of origin. No mean difference between landrace and variety germplasm emerged for forage quality (as leaf/stem ratio) and seed yield (Table 1). Within-population genetic variance was always much larger than among-population variance in landrace material (Table 1). In comparison, variety germplasm displayed lower within-population variance in absolute terms and with respect to among-population variance.

The outstanding agronomic value of Italian landraces in their area of origin, relatable to long-standing selective pressures entailed by their history of cultivation, supports their utilization through breeding procedures able to fully exploit their remarkable within-population diversity. Additional work is sheding light on reasons contributing to the their large specific-adaptation effects, suggesting to exploit these effects mainly by breeding distinct varieties for high- and low-drought stress environments.

Table 1. Mean value and ratio of within-population (s_W^2) to among-population (s_A^2) genetic variance for traits of landrace (LAN) and variety (VAR) germplasm groups.

	No. of entries		Mean value [a]		s_W^2 / s_A^2 ratio [b]		
Trait	LAN	VAR	LAN	VAR	LAN	VAR	Ref. [c]
DM yield (2 years; g/plant)	11	7	9.51	8.75 **	25.6 **	11.1 **	A
Main stem length (cm)	11	7	57.5	58.8 *	18.8 **	15.1 **	A
No. stems / plant	11	7	6.01	6.46 **	10.3 **	6.6 *	A
Plant survival (2 years; %)	11	7	79.8	64.2 **	–	–	A
No. florets / inflorescence	11	7	17.2	17.1 ns	70.5 **	4.5 *	A
Leaf-to-stem ratio	11	7	1.04	1.00 ns	48.0 **	7.3 **	B
DM yield (3 years; t/ha)	13	4	36.5	36.9 ns	–	–	C
Plant survival (3 years; %)	13	4	40.1	41.8 ns	–	–	D
Seed yield (t/ha)	13	4	1.11	1.06 ns	–	–	E
GE interaction variation	3	–	–	–	21.8 **	–	F

[a] Mean comparison: ns, not significant; *, $P < 0.05$; ** $P < 0.01$.

[b] Within-group comparison of s_W^2 vs. s_A^2: *, $P < 0.05$; ** $P < 0.01$.

[c] A = Euphytica 148, 269-282; B = Grass Forage Sci. 62, 100-103; C = Theor. Appl. Genet. 110, 219-227; D = Field Crops Res. 102, 51-59; E = Grass Forage Sci. 62, 507-510; F = estimation based on data in Theor. Appl. Genet. 114, 647-657.