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## Morphological variation among alfalfa cultivars with different cold hardiness

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**Key words:** alfalfa, morphological characters, regrowth vigor after frozen fall dormancy score

**Introduction** A reliable estimation for winter hardiness using growth habits in various seasons would be an extremely useful tool in an alfalfa improvement program in cold northern districts such as Heilongjiang Province in China. With this viewpoint, we studied on some relationships among various morphological characters in different growth stages and regrowth ability after controlled frozen treatments.

**Materials and methods** Five alfalfa cultivars (Table 1) were sown in pots on July 26, 2003. ① First internode length (FIL) and shoot height from axil of first true leaf (SHA) were measured on Aug. 26. ② All plants were clipped at a 5cm height at the beginning of flowering (Sep. 16), and primary growth (PG) was determined by weighing DM yield of the foliage. Two weeks later (Oct. 1), the longest shoot lengths were recorded as regrowth heights in fall (RHF). Then plants of five cultivars with different phenotypes were scored from 1 to 5 as phenotype score of fall regrowth (PSFR) on Oct. 10. ③ Four plants for each cultivar were excavated on Dec. 5 to evaluate root and crown traits including crown bud number, crown shoot number, crown DM and root DM. ④ The rest of plants prepared were transferred to a cold room to give a series of low temperatures (0~-15°C) for one weeks. Then the regrowing shoot heights were recorded with 5 days interval for evaluation of regrowth vigor (RV, the slope of regrowth curve) with them. All these morphological characters were related with regrowth vigor by SPSS data analysis system (Table 2).

**Results and discussion** Some researchers reported that cultivars with shorter FIL and lower RHF tend to have higher fall dormancy scores and winter hardiness. We, however, could not find any evidence for this character, because FIL and RHF hadn't significant correlations with RV. Inverse SHA and PSFR was positively correlated ( $P < 0.01$ ,  $P < 0.05$ ) to RV, when there was a negative ( $P < 0.05$ ) relation between PG and RV. And all of root and crown traits were not significantly related to RV (data not shown). That is against Schab's points.

**Table 1** Description of cultivars investigated.

Cultivar	Code	Original place	Fall dormancy score
Zhaodong	Ch-H	Heilongjiang of China	1—2
Xinjiangdaye	Ch-X	Xinjiang of China	3—4
Zhongmuyihao	Ch-C	CAAS of China <sup>*</sup>	4—5
AC Caribou	C-A	Canada	1
Fabulous	C-F	Canada	4.1

<sup>\*</sup> CAAS: The Chinese Academy of Agricultural Sciences

**Table 2** Correlations between morphological traits of different stages and regrowth vigor (RV) for different cultivars.

Cultivar code	FIL (cm)	SHA (cm)	PG (g/plant)	RHF (cm)	PSFR	RV
Ch-H	0.71	14.4	3.54	26.4	4.1	4.87
Ch-X	0.63	13.1	3.43	28.7	3.4	3.68
Ch-C	1.00	11.3	3.70	26.1	2.2	1.92
C-A	1.13	12.1	3.57	31.0	1.8	2.99
C-F	0.87	10.1	3.88	30.8	2.1	1.28
PC&	-0.521	0.994**	-0.828*	-0.389	0.838*	

Correlation coefficient between every traits and RV, \* significant at the 0.05 level, \*\* significant at the 0.01 level

**Conclusions** Cultivars with higher SHA, PSFR and lower PG showed stronger regrowth vigor after frozen. Therefore, higher SHA, PSFR, as well as lower PG is important characteristics to be considered during the selection of more tolerant cultivars to low temperature.

### Reference

Schwab, P. M., Barner, D. K., Sheaffer, C. C., 1996. Factors affecting a laboratory evaluation of alfalfa cold tolerance. *Crop Sci* 36, 318-324.