Persistency in Lolium x Festuca Hybrid Derivatives and its Relationships with Flowering Traits

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PERSISTENCY IN *LOLIUM X FESTUCA* HYBRID DERIVATIVES AND ITS RELATIONSHIPS WITH FLOWERING TRAITS

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ABSTRACT
Using amphiploid and backcrossed derivatives of Italian ryegrass x tall fescue hybrids, the paper emphasizes the interest of introgression vs amphiploidization in breeding for specific traits such as persistency or seed production from tall fescue or ryegrass resp. Persistency in amphiploid and *Lolium*-introgressed progenies were assessed in nursery together with variation of flowering traits. Persistency was found lower, on average, in introgressed progenies than in hybrid progenies but with enlarged variability within progeny suggesting possible advantageous rearrangements of fescue chromosomes. Although significantly associated, persistency in both populations was only very little affected by the variations in flowering traits such as flowering date, number of heads in Spring and reheading in Summer. As these traits are related to seed productivity to some extent, it is suggested that selecting for both high persistency and high seed production potential should not be incompatible and could be successfully applied in tetraploid introgressive population resulting from one single backcross of hybrid into ryegrass.

KEYWORDS
drought tolerance, persistency, polyploidy, intergeneric hybridization, introgression, ryegrass, fescue

INTRODUCTION
Lolium x *Festuca* hybrids are commonly experimented with in the Station of Lusignan for combining quality, high rate of establishment and persistency as tolerance against various environmental stresses. One remarkable feature of our intergeneric breeding programme is that we use, as parental fescue species, *Festuca arundinacea* var. *glaucescens*, a tetraploid wild relative species of the hexaploid cultivated tall fescue (Humphreys et al., 1995). As palatibility, voluntary intake and digestibility were clearly shown to be improved in hybrids compared with tall fescue (Ghesquière et al., 1996), attention has been more and more shifted towards persistency and its relationships with seed yield potential. Persistency in amphiploid hybrids is fairly high in nursery, especially after the summer drought which occurs regularly in Lusignan, while seed yield assessed in small rows remains low. As high seed yields are easily obtained in ryegrass, backcrosses of hybrids into Italian ryegrass have been carried out emphasizing persistency as a major objective of selection. The aim of this communication was to compare the persistency rate in polycrossed progenies derived either directly from amphiploid hybrids or after one generation of back-cross into tetraploid Italian ryegrass.

METHODS
Two tetraploid populations coming from *L. multiflorum* x *Festuca arundinacea* var. *glaucescens* hybrids were studied: one was set up by sampling 19 progenies from 3 independant polycrosses of G1- to G3-generation hybrids; the other resulted from backcrosses of hybrids into Italian ryegrass followed by 1 to 2 generations of polycrossing (22 and 28 progenies resp.). In spring 1994, the progenies were established in a nursery of spaced plants (0,70 m apart) according to 5 three-blocks designs (one per polycross) and at a rate of 10 individuals per progeny and per block. Flowering date (number of days after 1st April) was recorded in spring 1995 as well as the intensity of flowering rated as the number of stems on a 1-5 scale (1=few; 5=many). In July, all the individuals were cut and reheading was scored at the end of August (0=no head, 1=few, 2=many). Hydric stress was particularly severe in summer 1995 so that all the Italian ryegrass control varieties died while tall fescue survived perfectly well. Survival in the hybrid and introgressed progenies were scored four times during autumn 1995 and winter 1996. The last recording of survival was rated as the proportion of living tillers in each single plant on a 0-4 scale (0=dead, i.e. ryegrass-like, 1=25 %, 2=50 %, 3=75 %, 4=100 %, i.e. fescue-like) and was computed by analysis of covariance following the model: Polycross + Block(Polycross) + Progeny(Polycross) + heading date + flowering intensity + reheading. Between and within progeny variability were displayed as bar charts of the least-squares means of progenies and the individual residuals given by the analysis of covariance.

RESULTS AND DISCUSSION
The analysis of covariance indicated that progeny effect was only significant among the introgressed progenies. In both populations, reheading was a significant covariate ($F=31.31$ -$P<0.0001$ and $F=8.40$ - $P<0.01$ for the introgressed population and the hybrid one resp.), confirming that a high production of stems in summer is likely to be antagonist of persistency some months later. Within the hybrid population, earlier flowering was positively associated with higher persistency ($F=11.14$ - $P<0.001$) underlining the effect of *F. arundinacea* var. *glaucescens* which is an early flowering species compared to the tall fescue and the Italian ryegrass control varieties. Finally, the intensity of flowering in spring was only significantly associated with persistency ($F=20.49$ - $P<0.0001$) in the introgressed population, possibly because it was correlated with vigour of plants in terms of amount of tillers. Clearly, persistency was not physiologically controlled in the same way in both populations but would involve more or less specific traits in relation to the origin of the populations, *Lolium*-introgressed vs amphiploid. However, the coefficient of determination was low in both cases ($r2=0.18$) suggesting that the major components of persistency are still to be identified. Depth of the rooting system from *Festuca* allowing higher availability of water and better survival of tillers, could be one of them prior to the control of tillering balance by the flowering rate. This hypothesis is presently experimented in Lusignan at various scales of controlled environments (Durand et al., 1996) including selection of constrasted introgressed populations . As noted in Fig.1, heredity of persistency appeared highly additive among introgressed and amphiploid populations, in good agreement with their global *Festuca*-*Lolium* genomic balance (1:3 and 2:2 resp.). However, within-progeny variability was significantly higher in the introgressed population than in the amphiploid population ($X2=20.05$ $P<0.001$) and could be therefore partly of genetic nature. It is thus suggested that some of the fescue genes controlling persistency were quite regularly transmitted in the introgressed population and possibly rearranged in duplex at some loci. Data from genomic *in situ* hybridization, meiotic pairing at metaphase I and isozyme transmission rate gave already evidences that almost tetrasomic inheritance would be achieved in tetraploid population just following one back-cross into ryegrass. One key-question is now to state what are prospects for stabilizing and homogenizing such segregating populations over breeding generations. One way is diploidization through another culture of tetraploid introgressed hybrids and is on

progress at the INRA Station in Lusignan. As a conclusion, breeding ryegrass x fescue hybrids showed that associating persistency and seed potential would not be necessarily incompatible, even allowing to identify further genetic controls and their interrelationships.

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Figure 1

Persistency on the second year of establishment of *Festuca* x *Lolium* amphiploid hybrids and their progenies backcrossed into ryegrass: variability among (above) and within (below) progenies.