FABA BEAN: HETEROTIC INCREASE OBTAINED BY CROSSING ELITE *CULTIVARS*

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Summary

Heterosis for yield performance is well documented in faba bean for experimental material. We demonstrated that even for high yielding, elite cultivars, which already partly exploit heterosis, a heterotic increase of yield can be obtained.

Key words : *Vicia faba L., heterosis, breeding*

Introduction

One of the most important traits that has to be improved in faba bean (*Vicia faba* L.) is the level and the stability of yield. Several approaches are presently pursued: disease resistance, tolerance to late sowing and to drought, improvement of plant architecture, full exploitation of heterosis in hybrid cultivars (2). In genetic studies, hybrids are compared with their homozygous parents. In contrast to this, breeders have to compare their entries with released elite cultivars. To unify these aspects, we studied experimentally whether the performance of elite cultivars can further be increased by realizing additional heterosis.

Materials and Methods

Five presumably unrelated elite *cultivars*, Alfred, Caspar, Franz, Scirocco, Troy, were used. They were sown as seed and as pollen parents in all combinations in a modified topcross in 1992 at Hohehheim in the open field, including the *inter se* combinations (to maintain the *cultivars*). Polle parents were grown in six-fold numerical preponderance. Natural pollination was effectuated by bees and bumble-bees. For the white-flowering *cultivar* Caspar the degree of outcrossing could be assessed using flower colour as marker. The topcross progenies were evaluated for agronomic performance in 1993 at Hohenheim and Oberer Lindenhof (South West Germany) and at Lundsgaard (near to the German-Danish border) using lattice designs. Plot size was 5 m² with 30 plants/m² and three replicates per location. Anthesis, maturity, plant height, lodging, thousand kernel weight (TKW) and yield were assessed (at Lundsgaard: only yield).

Results and Discussion

The topcross progenies were on average not significantly different from the *inter se* progenies for anthesis, maturity, plant height, lodging, and TKW (Table 1); *e.g.*, the topcross progenies were on average only 1% taller and had a TKW of 2% greater than the *inter se* progenies. In contrast to this, average yield of the 19 topcross progenies was 5.67 t/ha compared to 5.24 t/ha of the five *inter* se progenies. This overall difference (8%) was significant at P = 0.05 (h^2 for yield was 0.88). The most promising combinations (referring to yield) included the Austrian *cultivar* Franz, yielding on average 6.92 t/ha, *i.e.*, surpassing the high yield of Franz (6.68 t/ha). n the topcross progeny of Caspar, the frequency of intervarietal F_1-plants was 50% compared to 15% in its *inter se* progeny. We assume this to be rather similar for the other combinations. Hence, the heterotic increase that occured seems to equal about one third (50% - 15% = 35%) of the expected increase that would occur in true (*i.e.*, with 100% outcrossing) intervarietal hybrids.

We know from the literature (2) that by maximizing heterosis the performance and yield stability of faba bean can be markedly increased. This effect seems to hold true for the elite *cultivars* that were used here. Our findings have to be regarded in connection with improved perspectives for breeding hybrid cultivars in faba bean (1).

Table 1. Performance[a] of 19 topcross progenies and five *inter se* progenies (underlignes) among five elite faba bean *cultivars* at two locations for anthesis and maturity (days > January 1st), plant heigt at maturity (cm), lodging (1 - 9,1 = upright, 9 = totally lodged), thousand kernel weight (TKW, g) and yield (t/ha).

Female parent/ Trait	Male parent Alfred	Caspar	Franz	Scirocco	Troy	Mean of topcross progenies
Alfred						
Anthesis	*152*	152	150	151	151	151
Maturity	*237*	240	239	237	237	238
Height	*119*	111	133	120	118	121
Lodging	*2.1*	1.0	1.0	1.0	1.0	1.0
TKW	*505*	509	552	522	518	525
Yield	*5.80*	5.52	6.98	5.85	6.18	6.13
Caspar[c]						
Anthesis	151	*149*	151	148	149	150
Maturity	240	*239*	243	240	241	241
Height	100	*99*	118	105	106	107
Lodging	1.0	*1.0*	1.1	1.0	1.0	1.0
TKW	506	*492*	508	547	516	519
Yield	3.13	*3.35*	3.64	4.92	3.15	3.70
Franz						
Anthesis	153	-[b]	*150*	152	151	152
Maturity	244	-[b]	*245*	243	243	243
Height	138	-[b]	*140*	144	139	140
Lodging	3.3	-[b]	*5.1*	2.5	3.6	3.0
TKW	527	-[b]	*534*	530	533	530
Yield	6.66	-[b]	*6.68*	6.92	7.18	6.92
Scirocco						
Anthesis	149	149	148	*148*	149	149
Maturity	239	236	238	*237*	236	237
Height	107	107	121	*117*	109	111
Lodging	1.0	1.3	1.0	*1.0*	1.0	1.1
TKW	508	493	545	*508*	491	509
Yield	5.65	5.18	6.61	*5.42*	4.90	5.58
Troy						
Anthesis	150	150	150	149	*152*	150
Maturity	233	233	233	233	*234*	233
Height	110	116	126	106	*104*	115
Lodging	1.0	1.0	2.5	1.3	*1.0*	1.5
TKW	507	514	503	498	*508*	506
Yield	5.60	6.56	6.17	5.75	*4.93*	6.02

[a] LSD(0.05): anthesis=2.1, maturity=4.7, plant height=13, lodging=1.5, TKW=30, yield=10.8

[b] not assessed

[c] emergency of Caspar was only 91% of the general mean

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