TRAITS RELATED TO KERNEL SETTING OF SUBAPICAL EAR IN MAIZE HYBRIDS

G. MADDONNI(1,2), M. PARCO(1), S. INCOGNITO(3) and C. G. LÓPEZ(3)

(1) Vegetal Production Department, School of Agriculture, University of Buenos Aires. Av. San Martín 4453, Buenos Aires (C1417DSE), Argentina. (2)IFEVA-CONICET (3) University of Lomas de Zamora, km 2 route 4, Lavallol, Argentina.

INTRODUCTION

Maize grain yield is generally optimized at population densities at which only apical ears contribute to total kernel number per area (1). Under restrictive environments low plant population densities are commonly used with the same genotypes and fertile sub-apical ears also contribute to total kernel number (2). Several studies (3, 4) have analyzed the strategies of different hybrids to set kernels in apical ears, such as reproductive efficiency (i.e. kernel number plant per unit of plant growth rate around silking, KNP PGR^{-1}, KN per unit of apical ear growth rate around silking, KNE1 EGR1^{-1}) and biomass partitioning to apical ears around silking (i.e. EGR E1 PGR^{-1}). However, information about kernel setting in sub-apical ears is only restricted to KNP PGR^{-1} (3, 4).

OBJECTIVE: to analyze the different traits related to kernel setting of both apical and sub-apical ears of four commercial maize hybrids released during the last four decades in Argentina.

MATERIALS AND METHODS

Two experiments were conducted at the field of the Vegetal Production Department FA-UBA (34º 35' S, 58º 29' W), Argentina, during 2012/13 (Exp. 1) and 2013/14 (Exp. 2) with irrigation, appropriate control of biotic agents and fertilized.

EXPERIMENTAL DESING:

Genotypes (and decade of release): DK3F22 (1980), DK752 (1990), DK747 (2000) and DK7210 (2010) from Dekalb Monsanto, Argentina.

Plant populations: 4 plants m^{-2} (low), 8 plants m^{-2} (optimum) and 12 plants m^{-2} (high).

Design: Split plot design (plant density in the main plots and hybrids in the subplots) with three replicates.

Sub-Plots: 3 rows of 5 m length and 0.7 m between rows

MEASUREMENTS:

Ten plants per sub-plot were tagged and allometric measurements were performed to estimate: plant (PGR), and ear growth rate of apical (EGR E1) and sub-apical ears (EGR E2) around silking. At physiological maturity total kernel number per plant (KNP), and per apical (KNE1) and sub-apical ears (KNE2) were counted.

DATA ANALYSIS:

Curvilinear relationships between KNP and PGR and EGR (7) and linear relationships between EGR and PGR (8) were fitted. Traits were submitted to ANOVA.

RESULTS

1- Total KNP decreased in response to plant density effect on PGR (Fig. 1 and Table), but modern hybrids always set more kernels than the older hybrids (plant density x hybrid not significant), despite their similar PGR values (Fig.1 and Table). Curvilinear model described these relationships.

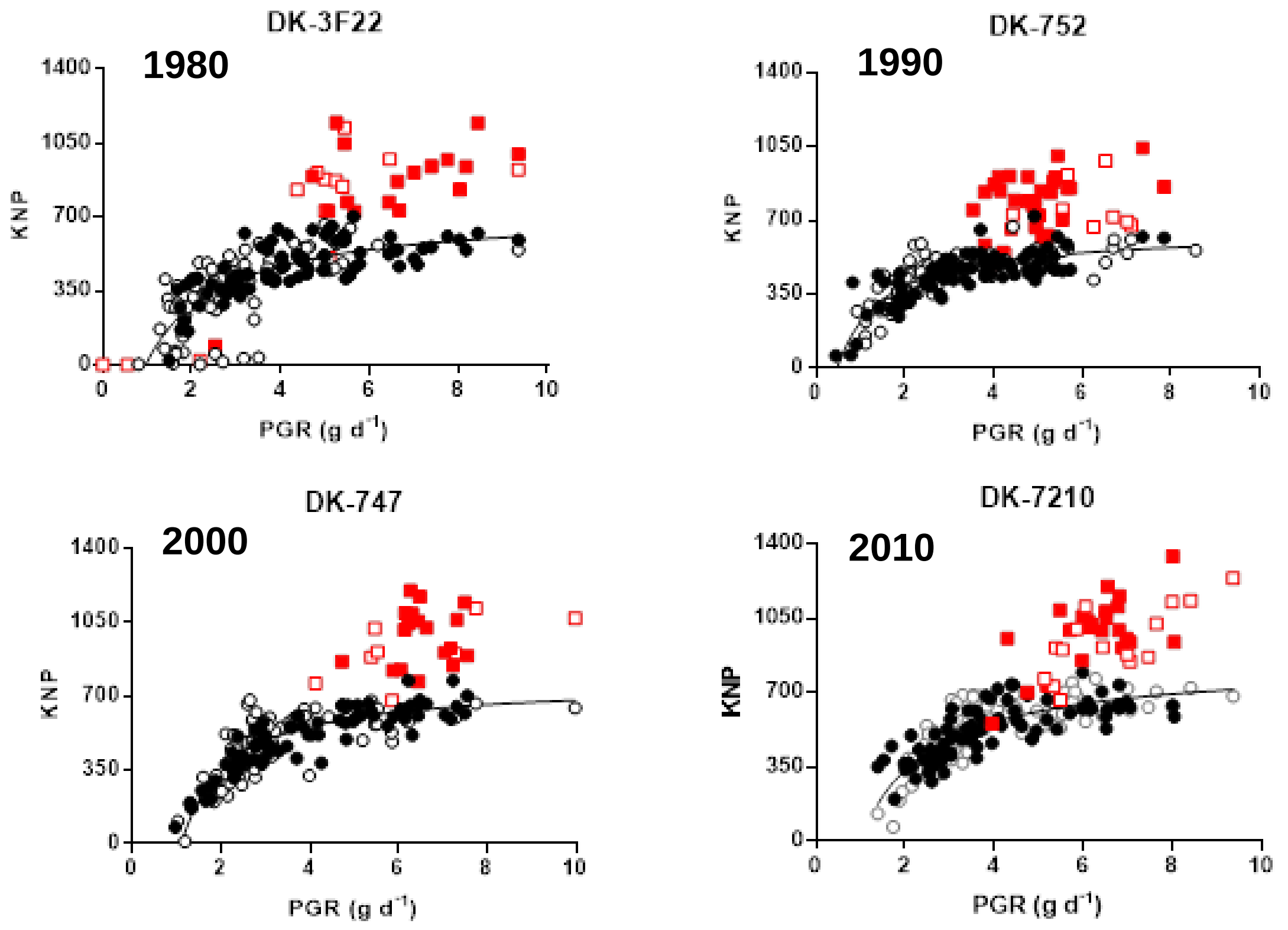

Figure 1: Kernel number per plant as a function of plant growth rate around silking of four hybrids released in different decades. Close symbols data of Exp1, empty symbols data of Exp2. Black circles kernels of apical ear, red squares kernels of sub-apical ears.

2- Breeding did not affect biomass partitioning to apical (EGR E1/PGR ca. 0.44) and sub-apical (EGR E2/PGR ca. 0.08) ear around the critical period for kernel set (see Table and Fig. 2). Values of EGR E2/PGR were lower than those of EGR E1/PGR. Linear and bi-linear models described these relationships.

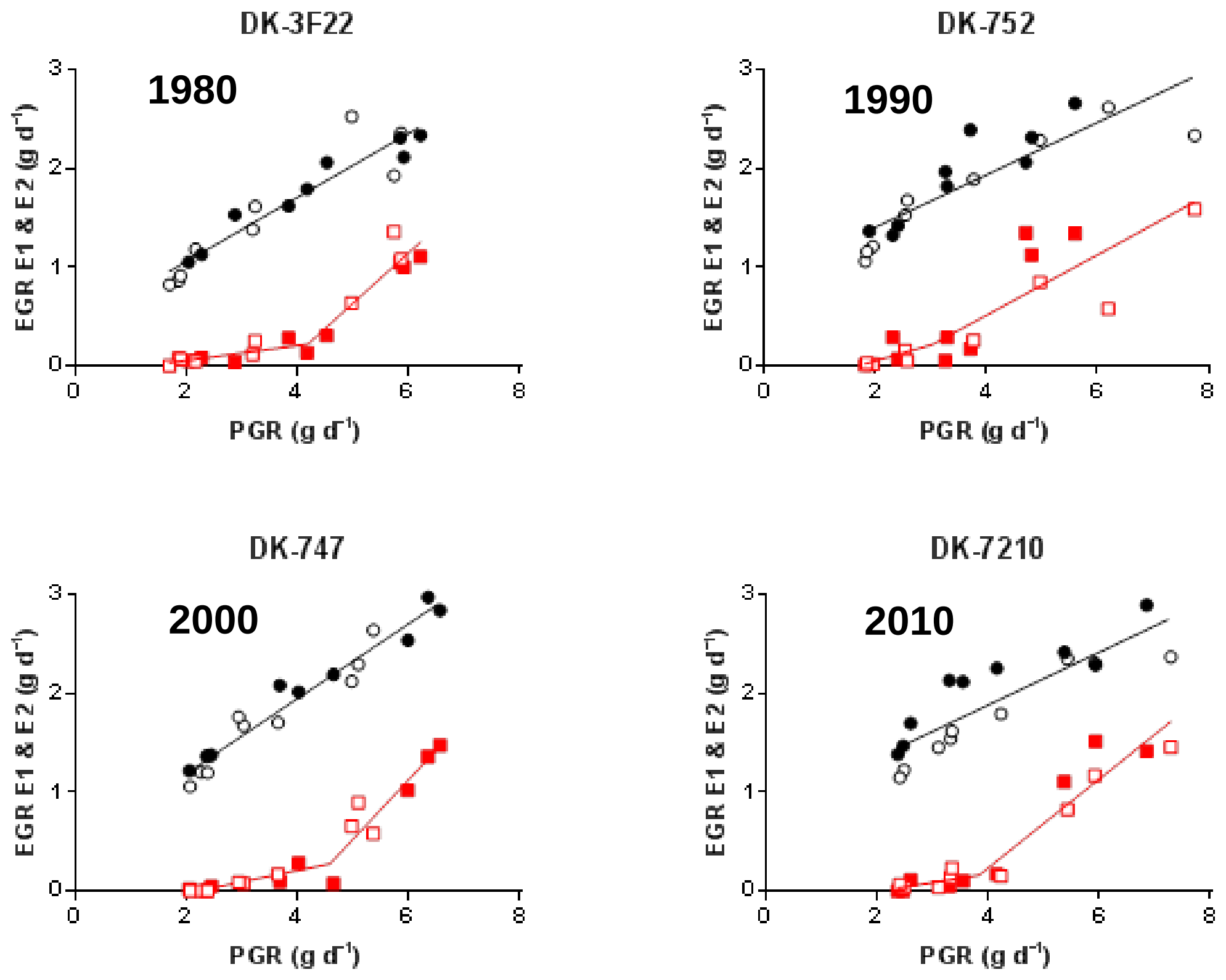

Figure 2: Growth rate of apical (E1) and sub-apical (E2) ear as a function of plant growth rate around silking. Symbols as in Fig. 1

3- Differences in KNP among hybrids and in kernel setting per unit of PGR were determined by breeding effect on reproductive efficiency of apical ear (KNE1/EGR E1, see Table and Fig. 2), without affecting reproductive efficiency of sub-apical ear (KNE2/EGR E2 see Table and Fig. 2). Values of KNE2/EGR E2 were always lower than those of KNE1/EGR E1.

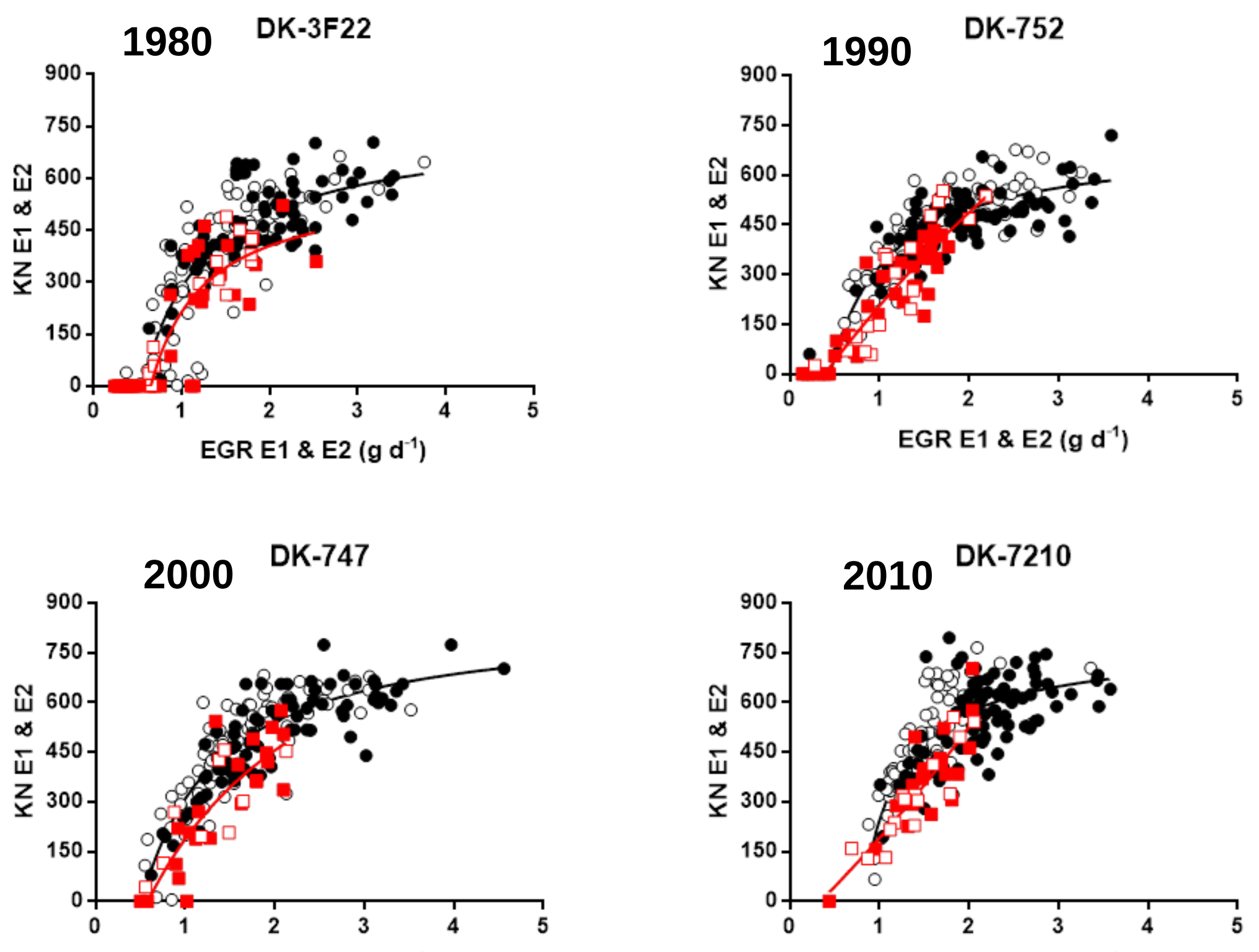

Figure 3: Kernel number per ear as a function of ear growth rate around silking. Symbols as in Fig. 1.

		PGR	EGR1	EGR2	EGR1/PGR	EGR2/PGR	KNP	KNE1	KNE2	KNP/PGR	KNE1/EGR	KNE2/EGR
		g/d										
Experiment (E)	1	4,01 a	1,96 b	0,49 b	0,51 a	0,09 b	565,77 b	476,77 b	90,58 a	142,98 a	244,63 a	63,44 a
	2	3,7 b	1,69 a	0,38 a	0,49 a	0,07 a	522,52 a	455,94 a	66,58 a	146,8 a	272,38 b	48,18 a
	p	*	*	*	ns	*	*	*	ns	ns	*	ns
Plant density (D) (pl/m2)	4	5,82 c	2,42 c	1,11 c	0,43 a	0,19 c	807,76 c	577,35 c	230,41 b	142,39 a	243,94 a	161,38 b
	8	3,51 b	1,83 b	0,16 b	0,53 b	0,04 b	487,34 b	482,29 b	5,05 a	144,42 a	268,26 b	5,66 a
	13	2,24 a	1,24 a	0,04 a	0,55 b	0,02 a	337,34 a	339,43 a	0,28 a	147,86 a	263,31 b	0,38 a
	p	*	*	*	*	*	*	*	*	ns	*	*
Hybrid (H)	DK-3F22	3,8 ab	1,64 a	0,43 a	0,44 a	0,08 ab	466,54 a	399,58 a	70,11 a	118,83 a	232,97 a	52,35 a
	DK-752	3,64 a	1,84 b	0,46 a	0,56 c	0,09 b	536,04 b	447,46 b	88,58 a	160,78 c	257,16 b	67,08 a
	DK-747	3,88 ab	1,91 b	0,38 a	0,51 b	0,07 a	559,83 b	492,84 c	66,99 a	147,87 b	262,03 b	44,6 a
	DK-7210	4,12 b	1,92 b	0,48 a	0,5 b	0,08 ab	614,18 c	525,55 d	88,63 a	152,08 bc	281,85 c	59,21 a
	p	ns	*	ns	*	ns	*	*	ns	*	*	ns
ExH	*p*	*	ns	ns	*	*	ns	*	ns	ns	*	ns
ExD	*p*	ns	*	*	ns	*	ns	ns	ns	*	ns	ns
HxD	*p*	ns	ns	ns	*	ns	ns	ns	ns	*	*	ns
ExHxD	*p*	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Table: ANOVA of measured/estimated traits

CONCLUSIONS

The objective of this work was initially focused on those traits related to kernel setting in sub-apical ears (as was stated in the title of the poster). Interestingly for the narrow number of genotypes tested, but those ones representatives of each decade, breeding effort was mainly restricted to a high kernel setting in apical ears, without affecting plant growth rate around silking and the growth of both apical and sub-apical ears during this critical period (i.e. no effect on biomass partitioning). Hence no breeding effect was detected in the reproductive efficiency of sub-apical ear. These results reveal that breeding was mainly focused for high potential environments where higher yields are obtained with plants bearing a high kernel setting in the single (apical) ear.

This work was financed by PICT 2012-1260

References:
(1) Andrade et al., 1999. Crop Sci. 39:453-459. (2) Maddonni and Bercovich, 2014. IJA Volume 2014, Article ID 195012. (3) Tollenaar et al., 1992. Crop Sci. 32:432-438. (4) Echarte et al., 2000. Field Crops Res. 68:1-8. (5) Vega et al., 2001. Crop Sci. 41:748-754. (7) Vega et al., 2001. Field Crops Res. 72:163-175. (8) Pagano and Maddonni, 2007. Field Crops Res. 101:306-320.