

b_{RGR} OF ACHENE DRY MATTER ACCUMULATION OF SUNFLOWER IS AN IMPORTANT CHARACTER

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SUMMARY

Research carried out by the Forage Research Institute Iregszemcse in 1995 revealed diversity in dynamic of achene dry matter accumulation (DMA) of sunflower hybrids by growth analysis. Twelve different hybrid genotypes (produced by factorial mating of 3 cms lines and 4 restorers) were planted in a randomized complete block design. During the period of maturity achene samples (six times at 7-day intervals, 5 heads per hybrid) were collected. Growth curves, equations and b_{RGR} were computed on the basis of a special formula, $\ln Y = P_0 + P_1 X + P_2 X^2$. In this case, relative growth rate (RGR) is a linear curve ($RGR_Y = P_1 + 2P_2 X$). Consequently, the curve of RGR is possible to be characterized by the coefficient of the variate X, $2P_2 = b_{RGR}$. Coefficient b_{RGR} defines the speed of the growth process. Achene dry matter accumulation can be described precisely by this model, because the cubic component was not significant. There were clear differences among DMA, absolute growth rate (AGR) and RGR of genotypes. The effect of parental lines on b_{RGR} was computed by the analysis of variance in M x N table (M = cms lines, N = restorer lines) without replications. Significant effect of cms lines on b_{RGR} was detected. Results indicate that the speed of DMA, which is measured by b_{RGR} , is an important heritable character of sunflower.

Key words: Achene dry matter accumulation, RGR, sunflower

INTRODUCTION

Development for yield stability is one of the major problems in sunflower breeding programs. Few years ago there was a good idea to investigate the process of achene dry matter accumulation (DMA) by growth analysis in sunflower. Perhaps the fast filling process of achenes is an important part of yield stability of hybrids (Csikász, 1998a). The objective of this study was to describe the achene DMA of different sunflower genotypes and detect the effect of the parents on b_{RGR} , which is the coefficient of X variate in equation of relative growth rate.

MATERIALS AND METHODS

Research carried out by the Forage Research Institute Iregszemcse in 1995, growth analysis, revealed diversity in the dynamic of achene DMA of sunflower hybrids. Twelve different hybrid genotypes were produced by factorial mating (Simmonds, 1979) in 1994. Three cms lines (cms3, cms6 and cms8) and four restorers (R32, R34, R40, and R59) were crossed. These lines were selected from synthetic populations except cms3, which was selected from HA89. Hybrids were planted in a randomized complete block design and four replications. During the period of maturity (six times at 7-day intervals) samples (5 heads per hybrid) were collected, threshed and dried (Berzsenyi, 1993). Growth curves, equations and b_{RGR} were computed on the basis of a special formula $\ln Y = P_0 + P_1 X + P_2 X^2$, (where $\ln Y =$ logarithm of DMA, $X =$ time, P_0 , P_1 and $P_2 =$ parameters of equation) according to Hunt and Parsons (1974) and Hunt (1982). This formula has a useful feature, because the relative growth rate (RGR) is a linear curve: $RGR = P_1 + 2P_2 X$. Consequently, the curve of RGR is possible to be characterized by the coefficient of variate X , $b_{RGR} = 2P_2$ (Csikász, 1998a, 1998b). The effect of parental lines on b_{RGR} was computed by the analysis of variance in $M \times N$ table ($M =$ cms lines, $N =$ restorer lines) without replications (Simmonds, 1979). According to Cressie (1978), the nonadditivity (remainder variance due to interaction between parental lines) was removed.

Table 1: Parameters, b_{RGR} and R^2 of fitted DMA equations of sunflower hybrids

No.	P_0	P_1	P_2	$b_{RGR} (=2P_2)$	R^2
332.	2,59	0,695	-0,060	-0,119	0,861**
334.	3,11	0,525	-0,050	-0,100	0,729**
340.	2,77	0,609	-0,047	-0,094	0,924***
359.	2,85	0,642	-0,054	-0,108	0,881**
632.	2,80	0,697	-0,062	-0,124	0,896***
634.	3,10	0,561	-0,045	-0,089	0,873**
640.	2,70	0,676	-0,050	-0,101	0,938***
659.	3,03	0,574	-0,046	-0,093	0,884**
832.	2,49	0,721	-0,060	-0,119	0,923***
834.	2,79	0,824	-0,082	-0,164	0,947***
840.	2,74	0,781	-0,077	-0,154	0,874***
859.	2,88	0,693	-0,067	-0,134	0,946***

No.: code number of hybrids, P_0 - P_1 - P_2 : parameters of equations of fitted DMA curves, b_{RGR} : coefficient of variate X in equation of RGR, ***: $P < 0.001$, **: $P < 0.01$

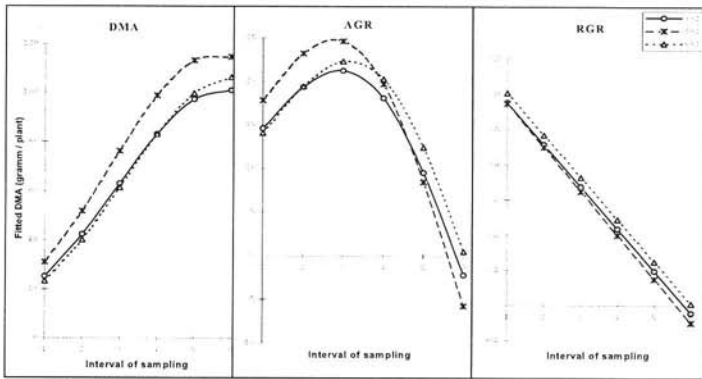


Figure 1: Fitted DMA, AGR and RGR curves of hybrids 332, 632 and 832

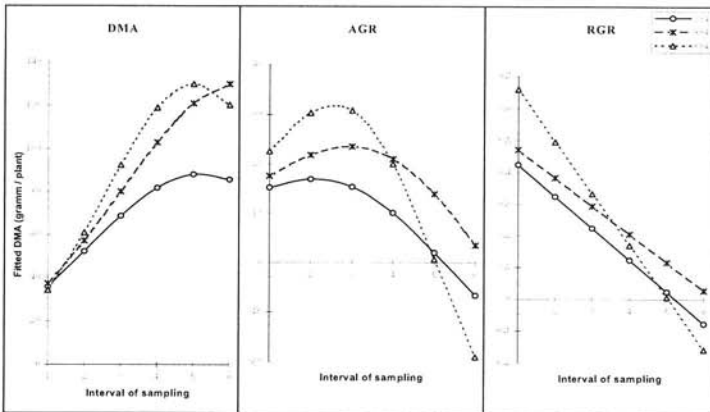


Figure 2: Fitted DMA, AGR and RGR curves of hybrids 334, 634 and 834

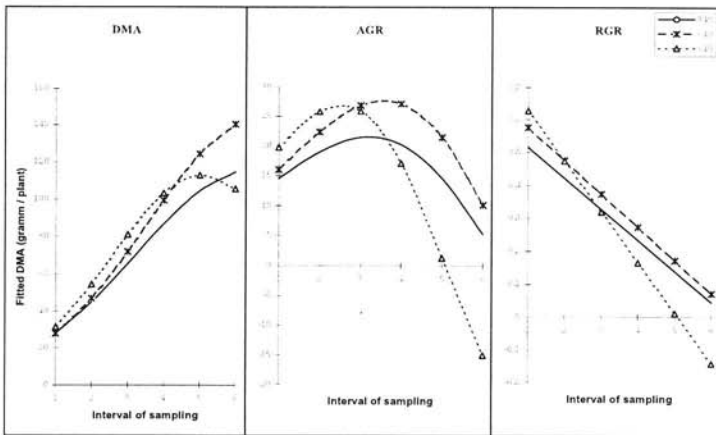


Figure 3: Fitted DMA, AGR and RGR curves of hybrids 340, 640 and 840

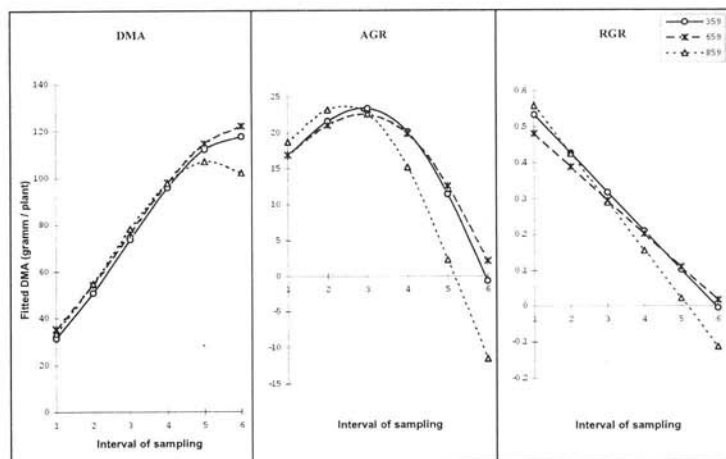


Figure 4: Fitted DMA, AGR and RGR curves of hybrids 359, 659 and 859

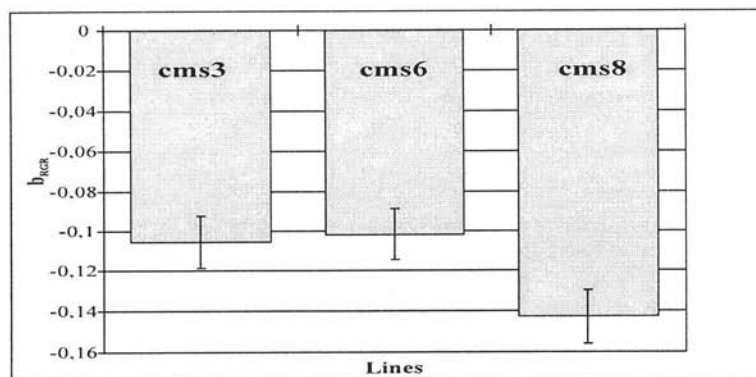


Figure 5: The effect of cms lines on b_{RGR}

RESULTS AND DISCUSSION

In Table 1, the parameters of equations, R^2 and b_{RGR} values are shown. Regarding the highly significant levels of R^2 values, achene dry matter accumulation can be described precisely by this model. The cubic component was not significant as revealed by the analysis of variance.

Figures 1-4 show the fitted DMA, AGR and RGR curves of hybrids. There are clear differences among DMA, AGR and RGR of genotypes. The genotypes 834, 840 and 859 (the names of hybrids came from the code number of the parental lines, 834 = cms8 / R34) have a definitely higher speed of DMA (low values of b_{RGR}) than the others. This result is underlined by b_{RGR} values (Table 2) and their analysis of

variance. A significant effect of cms lines was detected (Figure 5). The line cms8 appears to be a good genotype to contribute a higher rate of DMA of hybrids.

Table 2: The values of b_{RGR} of hybrids in M x N table

Line	R32	R34	R40	R59	Mean
cms3	-0,119	-0,100	-0,094	-0,108	-0,105
cms6	-0,124	-0,089	-0,101	-0,093	-0,102
cms8	-0,119	-0,164	-0,154	-0,134	-0,143
Mean	-0,121	-0,118	-0,116	-0,112	
LSD _{P=0.05}	0,0318 between means of cms lines				
LSD _{P=0.05}	0,0367 between means of restorer lines				

CONCLUSIONS

The main conclusions of the present study:

1. The $\ln Y = P_0 + P_1 X + P_2 X^2$ equation is suitable to describe DMA of achenes in sunflower.
2. Based on differences among curves of DMA, AGR and RGR of genotypes it is necessary to recognize a genetic control in this process.
3. The speed of DMA in achenes can be measured by b_{RGR} .
4. The results indicate that the speed of DMA in achenes is a heritable character.

Results may open new perspectives in breeding for yield stability of sunflower.

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EL COEFICIENTE b_{RGR} DE ACUMULACION DE MATERIA SECA DEL AQUENIO DEL GIRASOL ES UN CARÁCTER IMPORTANTE

RESUMEN

La investigación llevada a cabo por el Instituto "Forrage Research Iregyszencse", en 1995 mostró diversidad en la dinámica de la acumulación de materia seca en el aquenio (DMA) de híbridos de girasol por análisis del crecimiento. Los genotipos de doce híbridos diferentes (producidos por el cruce factorial de 3 líneas cms por 4 restauradoras) fueron sembradas en un diseño de bloques al azar. Durante el período de maduración se tomaron muestras del aquenios (seis veces en intervalos de 7 días, 5 capítulos por híbrido). Las curvas de crecimiento, ecuaciones y coeficientes b_{RGR} fueron computadas en base a una fórmula especial $\ln Y = P_0 + P_1X + P_2X^2$. En este caso, la Tasa de Crecimiento Relativo (RGR) es una curva lineal ($RGR_y = P_1 + 2P_2X$). Consecuentemente, la curva de RGR puede ser caracterizada por el coeficiente de la variable X, $2P_2 = b_{RGR}$. El coeficiente b_{RGR} define la velocidad del proceso de crecimiento. La acumulación de materia seca del aquenio puede ser descrita precisamente por este modelo, porque el componente cúbico no fue significativo. Hubo claras diferencias entre DMA, Tasa de Crecimiento absoluto y RGR de los genotipos. El efecto de las líneas parentales sobre b_{RGR} fue computado por el análisis de varianza en una tabla MxN M= líneas cms, N= líneas restauradoras) sin repeticiones. Se detectó un efecto significativo de las líneas cms sobre b_{RGR} . Los resultados indican que la velocidad de DMA, que se mide por b_{RGR} , es un importante y heredable, en girasol.

IMPORTANCE DE L'INDICE b_{RGR} D'ACCUMULATION DE MATIÈRE SÈCHE DANS L'AKÈNE DE TOURNESOL

RÉSUMÉ

L'étude réalisée en 1995 par l'Institut de recherche sur les fourrages d'Iregyszencse, a souligné par l'analyse de la croissance, l'existence d'une variabilité dans la dynamique d'accumulation de matière sèche (DMA) dans les hybrides de tournesol. Douze hybrides de tournesol (produits selon un schéma factoriel de 3 cms et 4 restaurateurs), ont été semés dans un dispositif bloc randomisé complet. Durant la période de maturation, des échantillons d'akènes ont été collectés (six fois à 7 jours d'écart et 5 capitules par hybride). Les courbes et équations de croissance et le b_{RGR} ont été calculés selon une formule spécifique, $\ln Y = P_0 + P_1X + P_2X^2$. Dans ce cas, la vitesse relative de croissance (RGR) est une courbe linéaire ($RGR_y = P_1 + 2P_2X$). Par conséquent, il est possible de caractériser la courbe de RGR par le coefficient de la variable X, $2P_2 = b_{RGR}$. Le coefficient b_{RGR} définit la vitesse du processus de croissance. L'accumulation de matière sèche dans l'akène peut être décrite précisément par ce modèle, car la composante cubique n'est pas significative. Il existe de nettes différences entre génotypes pour DMA, vitesse de croissance absolue (AGR) et RGR. L'effet des lignées parentales sur b_{RGR} a été calculé par analyse de variance dans une matrice M x N (M = lignées cms, N = lignées restauratrices), sans répétitions. Des effets significatifs sur le b_{RGR} sont détectés chez les lignées cms. Les résultats montrent que la vitesse de DMA, mesurée par le b_{RGR} est un caractère héritable important chez le tournesol.