

()

:

I

*

(// : // :)

(Zea mays L.)

Fv/Fm

I () **I** **A**) **I** () **I** ()

(
(**V**) (**V**) (**V**)
(**Fv/Fm** **Fm** **F**) (**V**)
% **F**

Fv/Fm

% **Fm**

) **I** .
() (

II

Fv/Fm

:

II

(F)

(Φ_p)

(Anonymous, 2005)

(QuinoneA)

/

II

(F_m)

(Maxwell &

(Φ_p)

.Johnson, 2000)

(Anonymous, 2005;

.FAO, 2006)

(Macdonald et al., 1993)

(Harder et al., 1982;

.Grant et al., 1989)

C

(Maxwell & Johnson,

.2000)

II

($F_v/F_m = (F_m - F_0) / F_m$)

(Earl et al., 2003; Cakir, 2004;

.Anonymous, 2005)

(F_v/F_m)

($F_v = F_m - F_0$)

(Macdonald et al., 1993;

II

.Andrews et al., 1995;)

(Masojidek et al., 1991; Grafts-Brander & Salvucci,
.2002; Yamasaki et al., 2002)

NADPH ATP

(Φ_{PSII}) II

(Quenching)

2. Photochemical quenching (qn)
3. Photosynthetically Active Radiation

1. Nonphotochemical fluorescence quenching (qNP)

() L () H (Cakir, 2004)

$$Q = \frac{I}{L} \left(\frac{L}{H} \right) H^{-1} \quad () Q$$

()

S.C. (V) S.C. (V) S.C.
(V) T.W.C. (V)

(Darkhal, 2003)

(O'Neill et al., 2006)

F : ()
F_m :

:II

$$F_v / F_m = (F_m - F) / F_m$$

(W) (L)
(Khajehpour et al., ()

. 1998)

$$= (\times) \times (/)$$

1. Maize Dwarf Mosaic Virus(MDMV)
2. Photosynthetic Photon Flux Density (PPFD)
3. Chlorophyll Fluorometer, Opti-Science, OS-30p, London
4. Leaf Area Index (LAI)

()

		A /		
		()	()	()
$(F_v/F_m \quad F_m \quad F)$	F			I
	%			I
				I
				I
.()	I F			
	/ I		/	
I I	.())	
F_m	/ / I I		/ /	(
	/ / I I			%
	F_v/F_m			
/	T.W.C.	S.C.		
S.C.	S.C.	F	/	
S.C.	F_m		/ /	
F_v/F_m		/ /	S.C.	
.()				

(%)	()	(%)	()	(%)	(%)	(%)
/	/	/	/	/		

$(F_v/F_m \quad F_m \quad F_0)$

F_v/F_m	F_m	F_0	F_v/F_m	F_m	F_0	
/ ns	ns	ns	/ **	ns	ns	
/ *	ns	ns	/ ns	ns	ns	
/			/			
/ ns	*	ns	/ ns	**	ns	
/ ns	ns	ns	/ ns	ns	ns	x
/			/			
		ns			% %	*** *

...

:

$(F_v/F_m \quad F_m \quad F_0)$

F_v/F_m	F_m	F_0	F_v/F_m	F_m	F_0	
/ a	a	a	/ a	a	a	I
/ a	a	a	/ a	a	a	I
/ b	a	a	/ a	a	a	I
/ a	a	a	/ a	a	a	I
/ a	a	a	/ a	a	a	V
/ a	ab	a	/ a	ab	a	V
/ a	b	a	/ a	b	a	V
/ a	a	a	/ a	ab	a	V

%

(2004) Morant-Manceau et al. .

F_v/F_m

F_m

%

(\quad)

/ I F

)

(

/ I

/ I I

F_m

/

/ / I I

(1991) Masojidek et al.

F_v/F_m

/ / S.C. T.C.

)

/ / T.C. S.C. F

(

/ T.C. S.C. F_m

F_v/F_m

/

(\quad)

(2002) Grafts-Brander & Salvucci

)

.(

$(\Phi_{II}) \Pi$

F_v/F_m

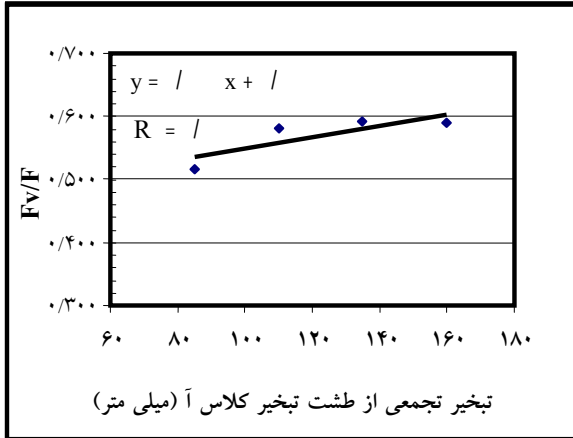
Φ_{II}

F_v/F_m

II

(Grafts-Brander & Salvucci, 2002)

(2006) O'Neill et al.

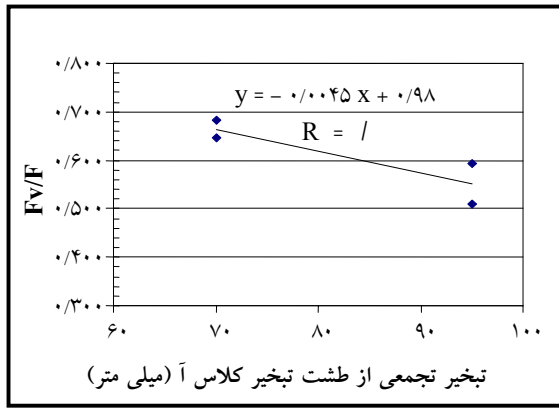


F_v/F_m

%

$(\Phi_{II}) PS_{II}$

I I



F_v/F_m

I I

F_v/F_m

()

S.C.

)

(/ / /)

(1992) Nesmith & Ritchie

%

/ I / I

/ S.C.

/ S.C.

()

... :

() I I

() T.W.C. S.C.

() (2004) Cakir

(Schussler & Westgate, 1991) (2000) Traore et al. .

(2002) Andrade et al.

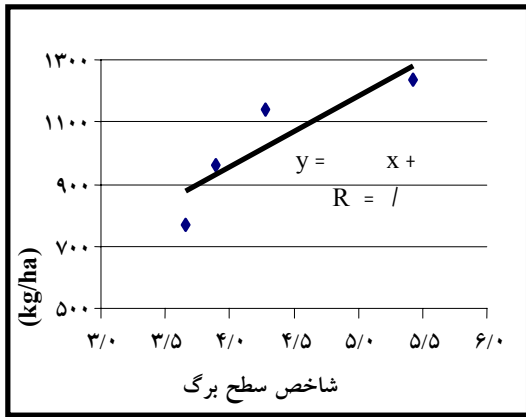
(Michelena & Boyer, 1982)

(Denmead & Shaw, 1960) (p< /)

I I .

(Wolfe et al., 1988a, b) T.W.C. S.C.

()	()		
a	/ a	/ a**	I
ab	/ ab	/ b	I
bc	/ bc	/ bc	I
c	/ c	/ c	I
ab	/ b	/ a	V
a	/ a	/ a	V
ab	/ ab	/ b	V
b	/ b	/ b	V



I

I

%

%

I

%)

)

($r = 1$)

F_v/F_m

II

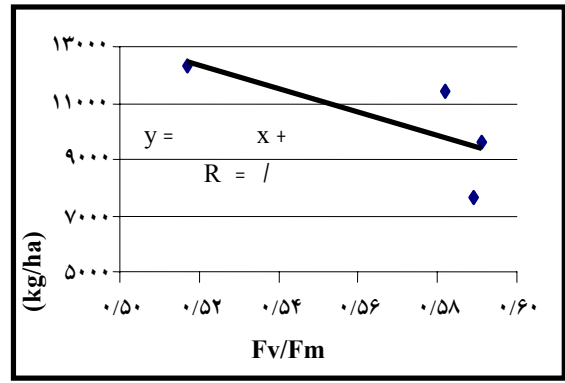
) F_v/F_m

و II

(

()

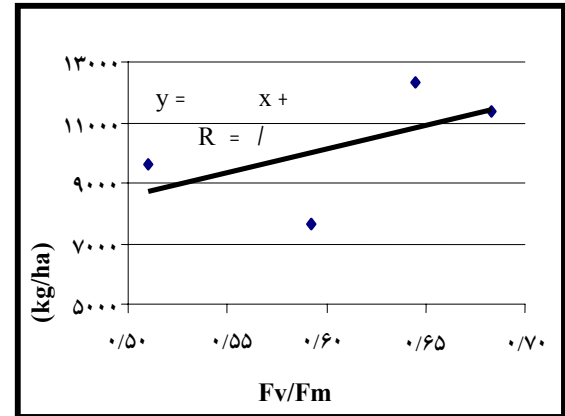
()



F_v/F_m

S.C.

()



F_v/F_m

REFERENCES

1. Anonymous. (2005). *Agriculture statistical report of I. R. Iran, fruits and crop plants products-2003*. Ministry of Jihad of Agriculture. (In Farsi).
2. Anonymous. (2005). *Methods of evaluating drought*. WWW.Agometeorology.ir. (In Farsi).
3. Andrade, F. H., Echarte, L., Rizzalli, R., Della Maggiora, A. & Casanovas, M. (2002). Kernel number predication in maize under nitrogen or water stress. *Crop Science*, 42, 1173-1179.
4. Andrews, J. R., Fryer, M. J. & Baker, N. R. (1995). Characterization of chilling effects on photosynthetic performance of maize crops during early season growth using chlorophyll fluorescence. *Journal of Experimental Botany*, 46, 1195-1203.
5. Cakir, R. (2004). Effect of water stress at different development stages on vegetative and reproductive growth of corn. *Field Crops Research*, 89, 1-16.
6. Darkhal, H. (2003). *An evaluation of climatic requirements for varying maize hybrids and their impacts on grain yield and components*. Project Report of Agricultural Research Institute of Isfahan. (In Farsi).
7. Denmead, O. T. & Shaw, R. H. (1960). The effects of soil moisture stress at different stages of growth on the development and yield of corn. *Agronomy Journal*, 52, 272-274.
8. Earl, H. J. & Davis, R. F. (2003). Effect of drought stress on leaf and whole canopy radiation use efficiency and yield of maize. *Agronomy Journal*, 95, 688-696.
9. FAO. (2006). Food and agriculture organization of the United Nations. Food outlook, Global market analysis. Statistical appendix. No.1. June.
10. Fardad, H. (1996). *Principles of irrigation: methods of irrigation*. Tehran University Press. Pp 442-459. (In Farsi).
11. Fryer, M. J., Andrews, J. R., Oxborough, K., Blowers, D. A. & Baker, N. R. (1995). Factors associated with depression of photosynthetic quantum efficiency in maize at low growth temperature. *Plant Physiology*, 108, 761-767.
12. Grafts-Brander, S. J. & Salvucci, M. E. (2002). Sensitivity of photosynthesis in a C4 plant, maize, to heat stress. *Plant Physiology*, 129, 1773-1780.
13. Grant, R. F., Jackson, B. S., Kiniry, J. R. & Arkin, G. F. (1989). Water-deficit timing effects on yield component in maize. *Agronomy Journal*, 81, 61-65.
14. Harder, H. J., Carlson, R. E. & Shaw, R. H. (1982). Yield, yield components, and nutrient content of corn grain as influenced by post-silking moisture stress. *Agronomy Journal*, 74, 275-278.
15. Khajehpour, M. R., Sharifzadeh, F. & Akbary, G. A. (1998). Estimating leaf area in maize. *Agricultural Sciences and Technology Journal*, 12 (1), 5-13. (In Farsi).
16. Macdonald, G. E., Shilling, D. G. & Bewick, T. A. (1993). Effects of endothall and other aquatic herbicides on chlorophyll fluorescence, respiration and cellular integrity. *Journal of Aquatic Plant Management*, 31, 50-55.
17. Masojidek, J., Trivedi, S., Halshaw, L., Alexiou, A. & Hall, D. O. (1991). The synergistic effect of drought and light stresses in sorghum and pearl millet. *Plant Physiology*, 96, 198-207.
18. Maxwell, K. & Johnson, G. N. (2000). Review article: Chlorophyll fluorescence—a practical guide. *Journal of Experimental Botany*, 51, 659-668.
19. Michelena, V. A. & Boyer, J. S. (1982). Complete turgor maintenance at low water potential in the elongation region of maize leaves. *Plant Physiology*, 69, 1145-1149.
20. Morant-Manceau, A., Pradier, E. & Tremblin, G. (2004). Osmotic adjustment, gas exchanges and chlorophyll fluorescence of a hexaploid triticale and its parental species under salt stress. *Journal of Plant Physiology*, 161, 25-33.
21. Nesmith, D. S. & Ritchie, J. T. (1992). Short – and long-term responses of corn to a pre-anthesis soil water deficit. *Agronomy Journal*, 84, 107-113.
22. O'Neill, P. M., Shanahan, J. F. & Schepers, J. S. (2006). Use of chlorophyll fluorescence assessments to differentiate corn hybrids response to variable water conditions. *Crop Science*, 46, 681-687.
23. Schussler, J. R. & E. Westgate, M. E. (1991). Maize kernel set at low water potential: II. Sensitivity to reduced assimilates at pollination. *Crop Science*, 31, 1196-1203.
24. Traore, S. B., Carlson, R. E., Pilcher, C. D. & Rice, M. E. (2000). Bt and non-Bt maize growth and development as affected by temperature and drought stress. *Agronomy Journal*, 92, 1027-1035.
25. Wolfe, D. W., Henderson, D. W., Hsiao, T. C. & Alvino, A. (1988a). Interactive water and nitrogen effects on senescence of maize: I. Leaf area duration, nitrogen distribution, and yield. *Agronomy Journal*, 80, 859-864.
26. Wolfe, D. W., Henderson, D. W., Hsiao, T. C. & Alvino, A. (1988b). Interactive water and nitrogen effects on senescence of maize: II. Photosynthetic decline and longevity of individual leaves. *Agronomy Journal*, 80, 865-870.

27. Yamasaki, T., Yamakawa, T., Yamane, Y., Koike, H., Satoh, K. & Katoh, S. (2002). Temperature acclimation of photosynthesis and related changes in photosystem II electron transport in winter wheat. *Plant Physiology*, 128, 1087-1097.