

()

*

()

(/ / : / / :)

(Oryza sativa L.)

() () :

(+ +) + + (+) +

(+ +) + + (+) +

)

/)

(Ea) (Er) (Ep)

/ / /

(/) (NHI)

(Fathi et al., 1999)

(Yoshida, 1981;

De Datta, 1986; Schnier et al., 1990)

)

(

.(Cassman et al., 1993)

.(Patil et al., 2001)

()

(Wilson et al.,

.1989; Peng et al., 1996)

(De Datta,

.1986; Wilson et al., 1989; Yoshida, 1981)

()

)

/ (

.(Ohnishi et al., 1999)

.(Singh et al., 1998)

(1997) Parsertasak & Fukali

/)
/ (

)

(

/) Riukuto-Norin12

(/ /) Todoroki-wase (/

... :

()

/ × / ×

(Er) (Ea)

(NHI) (Ep)

(Yoshida,1981; Peng et al., 1996; Fathi et al.,1999)

= _____ (

= _____ (

= _____ (

= _____ (

()

Panicle)

(initiation

()

.()

 _____ (Kg/ha)

SPSS SAS

()

.()

-
1. Agronomic Efficiency (Kg/Kg)
 2. Recovery Efficiency (Kg/Kg)
 3. Physiological Efficiency (Kg/Kg)
 4. Nitrogen Harvest Index (Kg/Kg)

(Cassam et al., 1993; Cassam et al., 1996; Peng et al., 1996; Ohnishi et al., 1999; Talcukdar et al., 2002)

()

) / ()

(

(1996) Peng et al.

()

/

(/)

)

)

(

(

/

(/)

(/)

() .

() .

/	x	ns	/	ns	/	ns	/	*	/	*	/	*	/	x	ns
/	x	**	/	*	/	**	/	**	/	**	/	**	/	x	ns
/	x		/		/		/		/		/		/	x	
/			/		/		/		/		/		/		%CV.
								%	%						** * ns

							()						
							PI	MT	Ba*				
/	a				/	f	/	c	/	e*			
/	a	/	b	/	bc	/	d	/	c	/	d		
/	a	/	a	/	c	/	bc	/	d	/	c		
/	a	/	a	/	a	/	a	/	c	/	ab	/	ab
/	a	/	ab	/	bc	/	c	/	b	/	b	/	bc
/	a	/	a	/	b	/	b	/	a	/	a	/	a
								PI		MT		Ba*	*

... :

()

()

()

()

(Peng & Cassman, 1998; Yang et al.,

()

.2003)

)

(

()

()

.(Peng & Cassman, 1998)

()

.(Dingkuhn et al., 1990)

()

(Peng & Cassman, 1998; Ying et

.al., 1998)

()

()

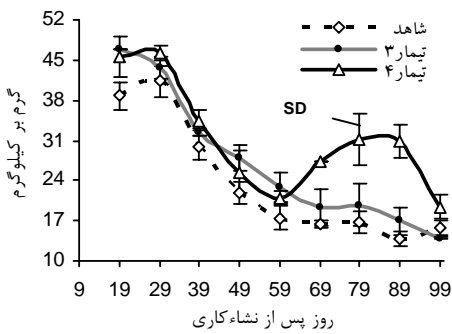
) / /

(

.(Iwasaki et al., 1993)

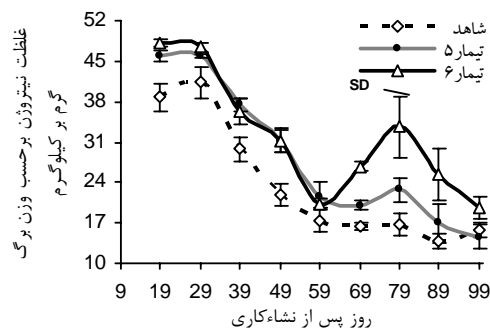
()

()



(

(



)

)

()

(IRRI)

(Cassman et al., 1996)

(1999) Ohnishi et al.

(Norman et al., 1992)

Talcukdar et al. .

(Honarnejad, 2001)

(2002)

/

()

(Yoshida, 1981;

.De Datta, 1986)

(Castillo et al.,

.1992)

(koochaki et al., 1997)

(Peng et al., 1996)

()

:

() /

/

()

(Singh et al., 1998)

... :

()

)

(

()

(Peng & Cassman, 1998)

(Peng et al., 1996)

:

(Castillo et al., 1992)

() (/)

(Ying et al., 1998) / /

/ /

(Singh et al., 1998)

()

(Parsertasak & Fukali, 1997; Singh et al., 1998)

(Schnier et al., 1994)

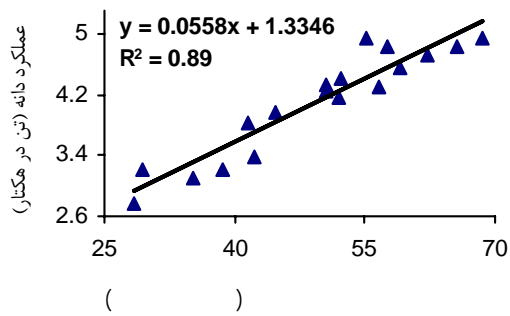
:

/

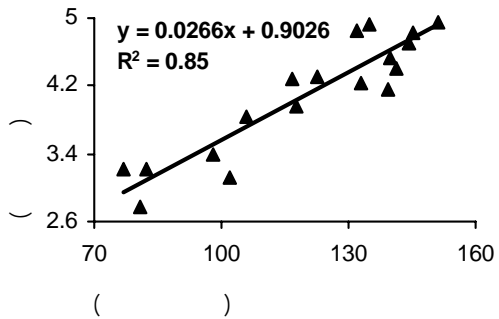
)

(

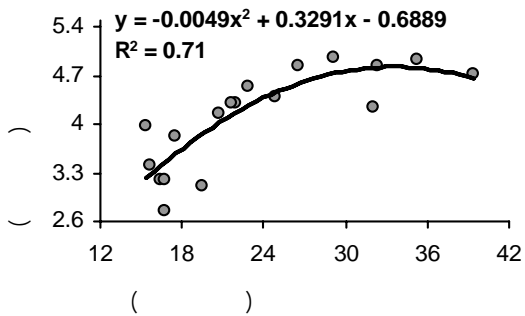
()



()



()



()

() ()
(
(Peng et al., 1996)

()

()

()

()

()

()

(1999) Asif et al.

()

()

(Patil et al., 2001)

...

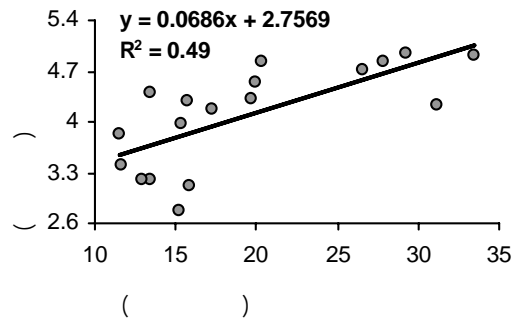
:

(Dingkuhn et al., 1992; Zhou et

al., 1992)

(Sasaki & Ishii, 1992)

.(Sasahara et al., 1993)



.(Horie et al., 1997)

Yoshida, 1981; Peng et al.,)

.(1999

(Kamiji & Horie, 1988)

)

(

(/)

.(Shi et al., 1994)

(/)

/ /

/

.(Patil et al., 2001)

(/)

(/)

(Cassman et al., 1996)

(/ /)

(Koutroubasa & Ntanos, 2003)(/)

(/)

(Cassman et al., 1996;

.Koutroubasa & Ntanos, 2003)

(Sasahara et al., 1993)

REFERENCES

1. Asif, M., Chaudhary, F. M. & Saeed, M. (1999). Influence of NPK levels and split N application on grain filling and yield of fine rice. *Soil Nutrient and Water Management*, 25(1), 30-31.
2. Cassamn, K. G., Kroff, M. J., Gaunt, J. & Peng, S. (1993). Nitrogen use efficiency of rice reconsidered: What are the key constraints? *Plant and Soil*, 155/156, 359-362
3. Cassman, K. G., Gines, G. C., Dizon, M. A., Samson, M. I. & Alcantara, J. M. (1996). Nitrogen-use efficiency in tropical lowland rice systems-contributions from indigenous and applied nitrogen. *Field Crops Research*, 47, 1-12.
4. Castillo, E. G., Buresh, R. J. & Ingram, K. T. (1992). Lowland rice yield as affected by timing of water deficit and nitrogen fertilization. *Agronomy Journal*, 84, 152-159.
5. De Datta, S. K. (1986). Improving nitrogen fertilizer efficiency in lowland rice in tropical Asia. *Fertilizer Research*, 9, 171-186.
6. Dingkuhn, M., Schnier, H. F., De Datta, S. K., Dorffling, S. K., Javellana, K. & Pamplona, R. (1990). Nitrogen fertilization of direct- seeded flooded vs. transplant rice: II. Interactions among canopy properties. *Crop Science*, 30, 1284-1292.
7. Dingkuhn, M., De Datta, S. K., Javellana, C., Pamplona, R. & Schnier, H. F. (1992). Effect of late season N fertilization on photosynthesis and yield of transplanted and direct-seeded tropical flooded rice. I. Growth dynamics. *Field Crops Research*, 28, 223-234.
8. Fathi, G. (1999). *Growth and mineral nutrition of field crops*. University Jehad of Mashhad Publication, pp. 372. (In Farsi).
9. Horie, T., Ohnishi, M., Angus, J. F., Lwein, L. G., Tsukaguchi, T. & Matano, T. (1997). Physiological characteristics of high yielding rice inferred from cross-location experiments. *Field Crops Research*, 52, 55-67.
10. Iwasaki, Y., Mae, T., Fukazawa, C., Makino, A., Ohira, K. & Ojima, K. (1993). Glutelin accumulation and changes in the levels of its mRNA in the superior and inferior spikelets of rice ear during ripening. *Plant and Soil*, 155/156, 211-214.
11. Kamiji, Y. & Horie, T. (1988). Nitrogen dynamics in soil crop system and grain production processes in rice influence of nitrogen pattern as induced by its different application on the growth and yield formation processes. *Journal of Agricultural Science*, 33(2), 171-180
12. Koochaki, A., Soltani, A. & Azizi, M. (1997). *Physiological plant ecology*. University Jehad of Mashhad Publication, pp. 271 (In Farsi)
13. Koutroubasa, S. D. & Ntanos, D. A. (2003). Genotypic differences for grain yield and nitrogen utilization in Indica and Japonica rice under Mediterranean conditions. *Field Crops Research*, 83, 251-260.
14. Norman, R. J., Guindo, D., Wells, B. R. & Wilson, C. E. Jr. (1992). Seasonal accumulation and partitioning of nitrogen-15 in rice. *Soil Science Society of America Journal*, 56, 1521-1527.
15. Ohnishi, M., Horrio, T., Homma, K., Supapoj, N., Takano, H. & Yamamoto, S. (1999). Nitrogen management and cultivars effects on rice yield and nitrogen efficiency in northeast Thailand. *Field Crop Research*, 64, 109-120.
16. Parsertasak, A. & Fukali, S. (1997). Nitrogen availability and water stress interaction on rice growth and yield. *Field Crops Research*, 52, 249-260.
17. Patil, S. K., Singh, U., Singh, V. P., Mishra, V. N., Das, R. O. & Henao, J. (2001). Nitrogen dynamics and crop growth on an Alfisol and Vertisol under a direct-seeded rainfed lowland rice-based system. *Field Crop Research*, 70, 186-199.
18. Peng, S. & Cassman, K. G. (1998). Upper thresholds of nitrogen up-take rates and associated nitrogen fertilizer efficiencies in irrigated rice. *Agronomy Journal*, 90, 178-185.
19. Peng, S., Sanico, A. L., Garcia, F. V. & Laza, R. C. (1999). Effect of leaf Phosphorus and Potassium concentration on chlorophyll meter reading in rice. *Plant Production Science*, 2(4), 227-231
20. Peng, S., Garcia, F. V., Laza, R. C., Sanico, A. L., Visperas, R. M. & Cassman, K. G. (1996). Increased N-use efficiency using a chlorophyll meter on high-yielding irrigated rice. *Field Crops Research*, 47, 243-252.
21. Sasahara, T., Satoh, S., Odaka, K. & Abe, T. (1993). Senescence parameters of organs constituting the panicle, first internode and flag leaf in rice. *Crop Science*, 33(3), 503-509.

22. Sasaki, H. & Ishii, R. (1992). Cultivar differences in leaf photosynthesis of rice bred in Japan. *Photosynthesis Research*, 32(2), 139-146.
23. Schnier, H. F., Dingkuhn, M., De Datta, S.K., Marqueses, E. P. & Faronilo, J. E. (1990). Nitrogen-15 balance in transplanted and direct-seeded flooded rice as affected by different methods of urea application. *Biology and Fertility of Soils*, 10, 89-96.
24. Schnier, H.F., De Datta, S.K. & Mengel, K. (1994). Dynamics of ¹⁵N-labeled ammonium sulfate in various inorganic and organic soil fractions of wetland rice soils. *Biology and Fertility of Soils*, 4, 171-177.
25. Shi, C. Y., Jin, L. F. & Xu, Y. W. (1994). A study of the effect of nitrogen on the vegetative characters of rice cultivar China No. 91. *Journal of Shandong Agricultural University*, 25(3), 267-271.
26. Singh, U., Ladha, J. K., Castillo, E. G., Punzalan, G., Tirol-Padre, A. & Duqueza, M. (1998). Genotypic variation in nitrogen use efficiency in medium- and long-duration rice. *Field Crops Research*, 58, 35-53.
27. Talcukdar, A. S. M. H. M., Sufian, M. A., Meisner, C. A., Duxbury, J. M., Lauren, J. G. & Hossain, A. B. S. (2002). Rice, wheat and mungbean yield in response to levels and management under a bed planting system. In: *Proceedings of 17th World Congress of Soil Sciences*, 14-21 Aug., Kasetsart University, Bangkok, Thailand, pp. 1256-1267.
28. Wilson, C. E. Jr., Norman, R. J., & Wells, B. R. (1989). Seasonal uptake patterns of fertilizer nitrogen applied in split application to rice. *Soil Science Society of America Journal*, 53, 1884-1887.
29. Yang, W. H., Peng, S., Huang, J., Sanico, A. L., Buresh, R. J. & Witt, C. (2003). Using leaf color charts to estimate leaf nitrogen status of rice. *Agronomy Journal*, 30, 261-270.
30. Ying, J., Peng, S., Yang, G., Zhou, N., Visperas, R. M. & Cassman, K. G. (1998). Comparison of high-yield rice in tropical and subtropical environments, II. Nitrogen accumulation and utilization efficiency. *Field Crops Research*, 57, 85-93.
31. Yoshida, S. (1981). *Fundamentals of rice crop science*. International Rice Research Institute, Los Banos, Philippines, 269pp.
32. Zhou, R. B., Gu, L. P. & Zhou, J. H. (1992). Study on improvement of rice fruiting and its nutrition's quality by intensifying the late nitrogen nutrition. *Plant Physiology*, 28(3), 171-176.