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 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)

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al., 1998)

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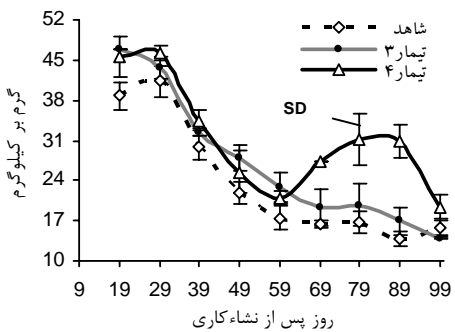
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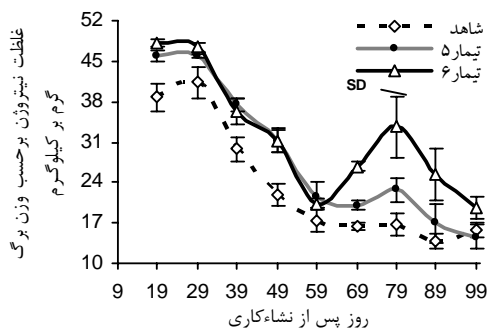
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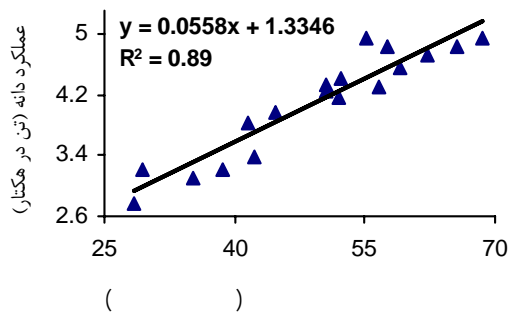
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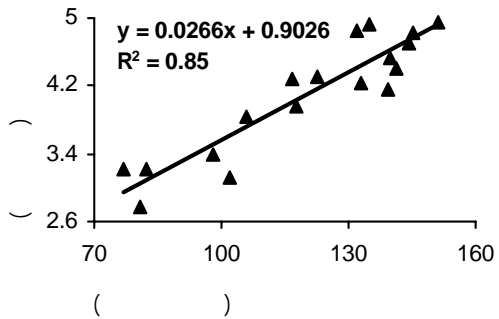
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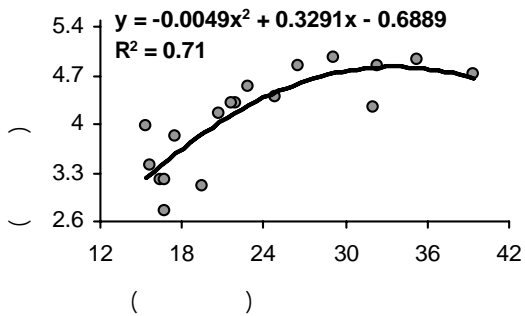
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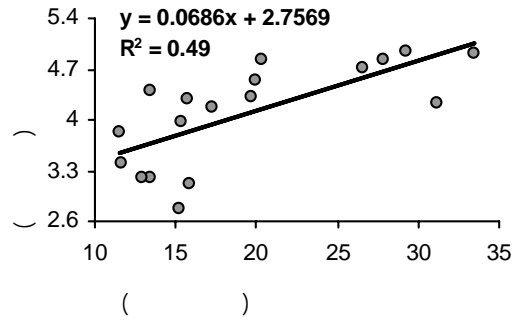
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(Sasaki & Ishii, 1992)

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.Koutroubasa & Ntanos, 2003)

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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 Jihad 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 Jihad 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.

