References

- Asher, C. J., and Blamey, F. P. C. 1987. Experimental control of plant nutrient status using programmed nutrient addition. J. Plant Nutr. 10: 1371-1380.
- Agrawala, S. C., Sharma, P. N., Chatterjee, C., and Shama, C. P. 1981. Development and enzymatic change during pollen development in boron deficiency maize plants. J. Plant Nutr. 3: 329-336.
- Agarwala, S. C. and Sharma, C. P., Chatterjee, C., and Nautiyal, B. D. 1984. Annual progress report of all-india coordinated scheme of micronutrients in soils and plants. Department of Botany, University of Lucknow, India. 127 pp.
- Anantawiroon, P., Subedi, K., and Rerkasem, B. 1997. Screening wheat for boron efficiency. Developments in Plants and Soil Sciences 76: 101-104.

 Proceedings of the International Symposium on Boron in Soils and Plants,
 September 7-11, 1997, Chiang Mai, Thailand. Dordrecht, The Netherlands:
 Kluwer Academic Publishers
- Ambak, K., and Tadano, T. 1991. Effect of micronutrient application on the growth and occurrence of sterility in barley and rice in a Malaysian deep peat soil. Soil Sci. Plant Nutr. 37: 715-724.
- Barr, R., Bottger, M., and Crane, F. L. 1993. The effect of boron on the plasma membrane electron transport and associated proton secretion by cultured carrot cells. Biochemistry and Molecular Biology International 31(1): 31-39.

- Bellaloui. N., and Brown, P.H. 1998. Cultivar differences in boron uptake and distribution in celery (*Apium graveolens*), tomato (*Lycopersicon esculentum*) and wheat (*Triticum aestivum*). Plant and Soil 198: 153-158.
- Bennett, M.D., Rao, M. K., Smith, J. B., and Bayliss, M. W. 1973. Cell development in the anther, the ovule and the young seed of *Triticum aestivum* L. var. Chinese Spring. Phil. Trans. Royal Soc. London Ser. B. 266: 39-81.
- Bergmann, W. 1992. Boron deficiency symptoms. *In* Nutritional Disorders of Plants-Development, Visual and Analytical Diagnosis. Fisher Verlag, Jena. Stuttgat. pp. 386-390.
- Blair, G.L. 1993. Nutrient efficiency- what do we really mean? *In* Genetic Aspects of Plant Mineral Nutrition. Eds. P J Randall, E. Haize, R A Richards and R Munson. Kluwer Academic Publishers, Dordrecht pp. 205-213.
- Blamey, F. P.C., Mould, B., and Chapman, J. 1979. Critical boron concentration in plant tissues of two sunflower cultivars. Agron. J. 71: 243-247.
- Broughton, W. J., and Dilworth, M.J. 1971. Control of leghaemoglobin synthesis in snake beans. Biochem. J. 125: 1075-1080.
- Brown, P. H., and Hu, H. 1996. Phloem mobility of boron is species dependent; evidence for phloem mobility in sorbitol-rice species. Ann. Bot. 77: 497-505.
- Brown, J. C., and Jones, W. E. 1971. Differential transport of boron in Tomato (Lycopersicon esculentum Mill.) Physiol. Plant. 25: 279-282.

- Brown, P. H. and Shelp, B. J. 1997. Boron Mobility in Plants. Plant and Soil 193: 85-101.
- Buso, G. S. C., and Bliss, F. A. 1988. Variability among lettuce cultivars grown at two levels of available phosphorus. Plant and Soil 111: 67-73.
- Cakmak, I., Kurz, H., Marschner, H., 1995. Short-term effects of boron, germanium and high light intensity on membrane permeability in boron deficient leaves of sunflower. Physiol. Plant. 95: 11-18.
- Chapman, V. J., Edwards, D. G., Blamey, F. P. C. and Asher, C. J. 1997. Challening the dogma of a narrow supply range between deficiency and toxicity of boron.

 In Boron in Soils and Plants. Proceedings. Eds. R W Bell and B Rerkasem.

 Kluwer Academic Publishers, Dordrecht, the Netherlands. pp 151-155.
- Cheng, C., and Rerkasem, B. 1993. Effect of boron in the pollen viability in wheat.

 Plant and Soil 155/156: 313-315.
- Cheng, C., and Rerkasem, B. 1992. Boron deficiency in wheat. Wheat special report No.11. Multiple Cropping Center, Chiang Mai University, Chiang Mai, Thailand; 132pp.
- Dambroth, M., and El Bassam, N. 1990. Genotypic variation in plant productivity and consequences for breeding of 'low-input cultivars'. *In* 'Genetic Aspects of plant Mineral Nutrition' (N. El Bassam, M. Dambroth and B.C. Loughman, eds.). Kluwer Academic, Dordrecht. pp. 1-7.

- Da Silva, A.R., and da Andrade, J.M.V. 1983. Influence of micronutrients on the male sterility, on upland wheat and on rice and soybean yields in red-yellow Latosol.

 Pesq. agropec bra. Brasilia 18: 593-601.
- Dell, B., Huang, L., and Bell, R.W. 2002. Boron in plant reproduction. *In* Boron in Plant and Animal Nutition. Eds HE Goldbach, B Rerkasem, MA Wimmer, PH Brown, M Thellier and RW Bell. Kluwer Academic Publishers, The Netherlands. pp 103-117.
- Findeklee, P., and Goldbach, H.E. 1996. Rapid effects of boron deficiency on cell wall elasticity modulus in *Cucurbita pepo* roots. Botanica Acta 109: 463-465.
- Graham, R. D. 1984. Breeding for nutritional characteristics in cereals. Adv. Plant Nutr. 1: 57-102.
- Gupta, U. C. 1979. Boron nutrition of crops. Adv. Agron. 31: 273-307.
- Goldbach, H.E., Hartmann, D., and Rotzer, T. 1990. Boron is required for the ferricyanide induced proton release by auxins in suspension-cultured cells of *Daucus carota* and *Lycopersicon esculentum*. Physiologia Plantarum 80: 114-118.
- Goldbach, H.E., 1997. A critical review on current hypotheses concerning the role of boron in higher plants: suggestions for further research and methodological requirements. J. Trance and Microprobe Techniques. 15 (1): 51-91.

- Haneklaus, S., and Schnug, E. 1993. Genetic variability and pattern of mineral nutrients in varieties of *Triticum aestivum* and *Brassica napus*. Aspects of Applied Biology 34: 211-218.
- Hu, H., and Brown, P. H. 1994. Localisation of boron in cell walls of squash and tobacco and its association with pectin. Plant Physiol. 105: 681-689.
- Hu, H., Brown, P. H., and Labavitch, J. M. 1996. Species variability in boron requirement is correlated with cell wall pectin. J. Exp. Bot. 47: 227-232.
- Huang, L., Pant, J., Dell, B., and Bell, R. W. 2000. Effects of boron deficiency on anther development and floret fertility in wheat (*Triticum aestivum* L. Wilgoyne). Ann. Bot. 85: 493-500.
- Heslop-Harrison, J., Heslop-Harrison, Y. and Shivahna, K.R. 1984. The evaluation of pollen quality, and a further appraisal of the fluorochromatic (FCR) test procedure. Theor Appl Genet 67:367-375.
- Huang, L., Pant, J., Bell, R. W, Dell, B., and Deane, K. 1996. Effects of boron deficiency and low temperature on wheat sterility. *In* Sterility in Wheat I Sub-Tropical Asia: Extent, Causes and Solutions, ACIAR Proceedings No. 72. Eds HM Rawson and KD Subedi. ACIAR, Camberra. pp 90-101.
- Huang, L., Pant, J., Dell, B., and Bell, W. R. 2001. Boron supply into wheat (*Triticum aestivum* L. cv. Wilgoyne) ear whilst still enclosed within leaf sheaths. J. Exp. Bot. 52: 1731-1738.

- Hoagland, D. R., and Arnon, D. I. 1950. The water culture method for growing plants without soil. California Experiment Station Circular 347. Berkeley, CA: The College of Agriculture, University of California.
- Jamjod, S., and Rerkasem, B. 1999. Genotypic variation in response of barley to boron deficiency. Plant and Soil 215: 65-72.
- Jones, J. B. Jr. 1991. Plant tissue analysis in micronutrients. *In* Micronutrients in Agriculture. 2nd ed. Eds. JJ Mordtvedt, F R Cox, L M Shuman and R M Welch. SSSA Book Series no.4. SSSA, Madison, WI. pp 523-548.
- Keerati-Kasikorn, P., Bell, R. W., Panya, P., Gilmour, R. F., and Loneragan, J. F. 1993. Comparison of seed yield and quality of peanut (*Arachis hypogaea* L.) cultivars in low fertility soils and their response to boron and complete fertiliser. In Plant Nutrition from Genetic Engineering to Field Practice. Ed. N J Barrow. Dev. Plant Soil Sci. 54: 409-412.
- Li, W. H., Kui, M. C., Chao, W. S., Jern, H. P., Li, C. R., Chu, W. J. and Wang, C. L. 1978. Studies on cause of sterility of wheat. J. Northeast. Agric. College 3: 1-19.
- Lohse, G. 1982. Microanalytical azomethine-H method for boron determination in plant tissues. Commun. Soil Sci. Plant Anal. 13: 127-134.
- Luo, Y. Sh. 1998. Boron uptake by different oilseed rape (*Brassica napus* L.) genotypes as influenced by soil moisture and NPK fertilizers. *Ph.D Thesis*. Zhejiiang Agricultural University, Hangzhou, Chiana.

- Lynch, J. 1998. The role of nutrient efficient crops in modern agriculture. Journal of Crop Production. 1: 241-264.
- Lee, S.G., and Aronoff, S. 1966. Investigations on the role of boron I plants. III.

 Anatomical observations. Plant Physiology 41: 1570-1577.
- Martens, D. C., and Westermann, D. T. 1991. Fertiliser applications for correcting micronutrient deficiencies. *In* Micronutrients in Agriculture. 2nd ed. Eds. J J Mordtvedt, F R Cox, L M Shuman and R M Welch. SSSA Book Series no. 4. SSSA, Madison, WI. pp 549-592.
- Match, T., Kawagochi, S., and Kobayashi, M. 1996. Ubiquity of a borate-rhamnogalacturonan II complex in the cell walls of higher plants. Plant Cell Physiol. 37: 636-642.
- Match, T., Ishigaki, K., Mizutani, M., Matsunaga, W., and Takabe, K. 1992. Boron nutrition of cultured tobacco BY-2 cells. I. Requirement for and intracellular localisation of boron and selection of cells that tolerate low levels of boron. Plant Cell Physiology 33: 1135-1141.
- Marschner, H. 1995. Mineral nutrition of higher plants. 2nd Edition. Academic Press, London. Pp 88-92.
- .Nable, R. O. 1988. Resistance to boron toxicity amongst several barley and wheat cultivars-A preliminary examination of the resistance mechanism. Plant and Soil 112: 45-52.

- Nable, R. O., Cartwright, B. and Lance, R. C. M. 1990. Uptake of boron and silicon by barley genotypes with differing susceptibilities to boron toxicity. Ann. Bot. 66: 83-90.
- Nable, R. O. 1991. Distribution of boron within barley genotypes with differing susceptibilities to boron toxicity. J. Plant Nutr. 14: 453-461.
- Parr, A.J., and Loughman, B.C. 1983. Boron and membrane function in plants. *In* Metals and Micronutrients. Uptake and Utilisation by Plants. Ed. Robb D.A. and Pierpoint, W.S. Academic Press, New York pp. 87-107.
- Paull, J. G., Nable, R. O., Lake, A. W. H., Materne, M. A. and Rathjen, A. J. 1992.

 Response of annual medics (*Medicago* ssp) and field peas (*Pisum sativum*) to high concentration of boron: genetic variation and the mechanism of tolerance.

 Austr. J. Agri. Res. 43: 203-213.
- Pilbeam, D.J., and Kirkby, E.A. 1983. The physiological role of boron in plants. J. Plant Nutr. 6: 563-582.
- Pope, D. T., and Munger, H. M. 1953. The inheritance of susceptibility to boron deficiency in celery. Proc. Amer. Soc. Hort. Sci. 61: 163-172.
- Pollard, A.S., Parr, A.J., and Loughmann, B.C. 1977. Boron in relation to membrane function in higher plants. J. of Expt. Bot. 28:831-841.
- Rawson, H. M., and Hofstra, G. 1969. Translocation of remobilization of ¹⁴C assimilated at different stages by each leaf of the wheat plant. Aust J Biol Sci 22: 321-331.

- Rawson, H. M. 1996. The developmental stage during which boron limitation causes sterility in wheat genotypes and the recovery of ferility. Aust. J. Plant Physiol. 23:709-717.
- Robertson, G.A., and Loughman, B.C. 1974. Response to B deficiency: A comparison with responses produced by chemical methods of retarding root elongation.

 New Phytol. 73: 821-832.
- Rerkasem, B. 1986. Boron deficiency in sunflower and green gram at Chiang Mai.

 Journal of Agriculture (Chiang Mai University) 2: 163-72 (in Thai, with English abstract).
- Rerkasem, B. 1990. Comparison of green gram (Vigna radiata) and blackgram (Vigna mungo) in boron deficiency. In Proc. Mungbean Meeting 90. (Eds. C Thavarasook, P Srinives, N Bookerd, H lmai, A Pookpakdi, P Laosuwan and U Pupipat). Bangkok Office of Tropical Agriculture Research Center, Japan. Pp 167-174.
- Rerkasem, B., and Jamjod, S. 1989. Correcting boron deficiency induced ear sterility in wheat and barley. Thai Journal of Soils and Fertilizers 11: 200-209 (in Thai with English summary).
- Rerkasem, B., and Lordkaew, S. 1992. Predicting grain set failure with tissue boron analysis. In: Mann, C. E. and Rerkasem, B., ed. Boron deficiency in wheat.

 Wheat special report No. 11. Mexico DF, CIMMYT. pp. 9-14.

- Rerkasem, B. and Loneragan, J. F. 1994. Boron deficiency in two wheat genotypes in a warm, subtropical region. Agron. J. 86: 887-890.
- Rerkasem, B., and Lordkaew, S. 1995. Tissue Boron. *In* Sterility in Wheat in Sub-Tropical Asia: Extent, Causes and Solutions. Eds HM Rawson and KD Subedi ACIAR Proc. No. 72. pp. 36-38.
- Rerkasem, B., and Jamjod, S. 1997a. Boron deficiency induced male sterility in wheat (*Triticum aestivum* L.) and implications for plant breeding. Euphytica 96: 257-262.
- Rerkasem, B. and Jamjod, S. 1997b. Genetypic variation in plant response to low boron and implications for plant breeding. Plant and Soil 193: 169-180.
- Rerkasem, B., Netsangtip, R., Bell, R. W., and Loneragan, J. F. 1988. Comparative species responses to boron on a Typic Tropaqualf in Northern Thailand. Plant and Soil 106: 15-21.
- Rerkasem, B., Saunders, D. A., and Dell, B. 1989. Grain set failure and boron deficiency in wheat. J. Agric. (Chiang Mai University) 5: 1-10.
- Rerkasem, B., Netsangtip, R., Lordkaew, S., and Cheng, C. 1993. Grain set failure in boron deficient wheat. Plant and Soil 155/156: 309-312.
- Rerkasem, B., Lordkaew, S., and Dell, B. 1997. Boron requirement for reproductive development in wheat. Soil Sci. Plant Nutr. 43: 953-957.

- Rerkasem, B., and Lordkaew, S. 1996. Tissue Boron. *In* Sterility in Wheat in Sub-Tropical Asia Extent, Causes and Solutions, ACIAR Proceedings No. 72. Eds HM Rawson and KD Subedi. ACIR, Camberra. pp 36-38.
- Rerkasem, B., and Jamjod, S. 1999. Genotypic variation in response of barley to boron deficiency. Plant and Soil 215: 65-72.
- Richards, R. A., Condon, A. G., and Rebetzke, G. J. 2001. Trait to improve yield in day environment. In Application of physiology in wheat breeding. Eds M P Reynolds, JI Ortiz-Monasterio and A McNab. pp 88-100. Mexico DF, CIMMYT.
- Sakal, R., Singh, A. P., Singh, R.B., and Bhogal, N. S. 1991. Relative susceptibility of some important varieties of sesamum and mustard to boron deficiency in calcareous soils. Fertilizer News 36: 43-50.
- Shelp, B. J., and Shattuck, V. I. 1987. Boron nutrition and mobility, and its relation to hollow stem and the elemental composition of greenhouse grown cauliflower. J. Plant Nutr. 10(2): 143-162.
- Shelp, B. J., Penner, R., and Zhu, Z. 1992. Broccoli (*Brassica oleracea* var *italica*) cultivar response to boron deficiency. Can. J. Plant Sci. 72: 883-888.
- Sherrell, C. G. 1983. Effects of boron application on seed production of New Zealand herbage legumes. New Zealand J. Exp. Agric. 11: 113-117.
- Shorrocks, V.M. 1997. The occurrence and correction of boron deficiency. Plant and Soil 193: 121-148.

- Srivastava, S. P., Bhandari, T. M. S., Yadav, C. R., Joshi, M., and Erskine, W. 2000.

 Boron deficiency in lentil: Yield loss and geographic distribution in a

 germplasm collection. Plant and Soil 219: 147-151.
- Stangoulis, J. C. R., Grewal, H. S., Bell, R. W. and Graham, R. D. 2000. Boron efficiency in oilseed rape: I. Genotypic variation demonstrated in field and pot grown *Brassica napus* L. and *Brassica juncea* L. Plant and Soil 225: 243-251.
- Stangoulis, J. C. R., Brown, P. H., Bellaloui, N., Reid, R. J., and Graham, R. D. 2001.

 The efficiency of boron utilisation in canola. Aust. J. Plant Physiol. 28: 1109-
- Stangoulis, J.C.R. 1998. Genotypic variation in oilseed rape to low boron nutrition and the mechanism of boron efficiency. PhD Thesis Adelaide University.
- Subedi, K.D., Gregory, P.J., and Gooding, M.J. 1999. Boron accumulation and partitioning in wheat cultivars with contrast tolerance to boron deficiency.

 Plant and Soil 214: 141-152.
- Subedi, K. D., Budhathoki, C. B., Subedi, M., and Tuladhar, J. K. 1993. Survey and research report on wheat sterility problem (1992/93). LARC working Paper No. 93/49. Nepal, Lumle Agricultural Research Centre.
- Subedi, K. D., Budhathoki, C. B., Subedi, M., and Yubak, D. 1997. Response of wheat genotypes to sowing date and boron fertilization aimed at controlling sterility in a rice-wheat rotation in Nepal. Plant Soil 188: 249-256.

- Spurr, A.R. 1957. The effect of boron on cell-wall structure in celery. American Journal of Botany 44: 637-650.
- Tandon, J. P., and Naqvi, S. M. A. 1992. Wheat varietal screening for boron deficiency in india. *In*: Mann, C.E. and Rerkasem, B., ed. Boron Deficiency in wheat. Wheat Special Report No.11. Mexico DF, CIMMYT. pp. 76-78.
- Vergne, P., Delvallee, I., and Dumas, C. 1987. Rapid assessment of microspore and pollen development stage in wheat and maize using DAPI and membrane permeabilization. Stain Technol. 62: 299-304.
- Walker, J. C., Jolivette, J. P., and Hare, W. W. 1945. Varietal susceptibility in garden beet to boron deficiency. Soil Science 59: 461-464.
- Xue, J., Lin, M., Bell, R.W., Graham, R.D., Yang, X., Yang, Y. 1998. Differential response of oilseed rape (*Brassica napus* L.) cultivars to low boron supply.

 Plant and Soil 204: 155-163.
- Yang, X., and Romheld, V. 1999. Physiological and genetic aspects of micronutrient uptake by higher plants. *In* Plant Nutrition- Molecular Biology and Genetics.

 Eds G Nielsen and A. Jensen. Kluwer Academic Publishers. Prited in the Netherlands. pp 151-186.
- Yang, Y., Xue, J., Ye, Z., and Wang, K. 1993. Responses of rape genotypes to boron application. Plant and Soil 155/156: 321-324.

Zarinas, B.A., Cartwright, B., Spouncer, L.R. 1987. Nitric acid digestion and multielement analysis of plant material by inductively coupled plasma spectrometry.



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University All rights reserved