

## 引用文献

- Azad, A.K., Sawa, Y., Ishikawa, T., Shibata, H., 2004. Phosphorylation of plasma membrane aquaporin regulates temperature-dependent opening of tulip petals. *Plant Cell Physiol.* 45, 608-617.
- Bendahmane, M., Dubois, A., Raymond, O., Bris, M.L., 2013. Genetics and genomics of flower initiation and development in roses. *J. Exp. Bot.* 64, 847-857.
- Bielecki, R., Elgar, J., Heyes, J., Woolf, A., 2000. Flower opening in Asiatic lily is a rapid process controlled by dark-light cycling. *Ann. Bot.* 86, 1169-1174.
- Bonfig, K.B., Gabler, A., Simon, U.K., Luschin-Ebengreuth, N., Hatz, M., Berger, S., Muhammad, N., Zeier, J., Sinha, A.K., Roitsch, T., 2010. Post-translational derepression of invertase activity in source leaves via down-regulation of invertase inhibitor expression is part of the plant defense response. *Mol. Plant.* 3, 1037-1048.
- Brummell, D.A., Chen, R.K., Harris, J.C., Zhang, H., Hamiaux, C., Kralicek, A.V., McKenzie, M.J., 2011. Induction of vacuolar invertase inhibitor mRNA in potato tubers contributes to cold-induced sweetening resistance and includes spliced hybrid mRNA variants. *J. Exp. Bot.* 62, 3519-3534.

- Camardella, L., Carratore, V., Ciardiello, M.A., Servillo, L, Balestrieri, C., Giovane, A., 2000. Kiwi protein inhibitor of pectin methylesterase amino-acid sequence and structural importance of two disulfide bridges. *Eur. J. Biochem.* 267, 4561-4565.
- Cheng, W.H., Taliercio, E.W., Chourey, P.S., 1996. The miniature1 seed locus of maize encodes a cell wall invertase required for normal development of endosperm and maternal cells in the pedicel. *Plant Cell* 8, 971-983.
- Cosgrove, D.J., 1998. Cell wall loosening by expansins. *Plant Physiol.* 118, 333-339.
- Davies, C., Robinson, S.P., 1996. Sugar accumulation in grape berries - Cloning of two putative vacuolar invertase cDNAs and their expression in grapevine tissues. *Plant Physiol.* 111, 275-283.
- de Vetten, N.C. and Huber, D.J., 1990. Cell wall changes during the expansion and senescence of carnation (*Dianthus caryophyllus*) petals. *Physiol. Plant.* 78, 447-454.
- Devlin, P.F., Kay, S.A., 2000. Cryptochromes are required for phytochrome signaling to the circadian clock but not for rhythmicity. *Plant Cell* 12, 2499-2510.
- Doi, M., Miyagawa-Namao, M., Inamoto, K., Imanishi, H., 1999. Rhythmic changes

in water uptake, transpiration and water potential of cut roses as affected by photoperiods. *J. Jpn. Soc. Hort. Sci.* 68, 861-867.

Doi, M., Nakagawa, Y., Watabe, S., Aoe, K., Inamoto, K., Imanishi, H., 2003. Ethylene-induced leaf yellowing in cut chrysanthemums (*Dendranthema grandiflora* Kitamura). *J. Jpn. Soc. Hort. Sci.* 72, 533-535.

Dubois, A., Carrere, S., Raymond, O., Pouvreau, B., Cottret, L., Roccia, A., Onesto, J.P., Sakr, S., Atanassova, R., Baudino, S., Foucher, F., Le Bris, M., Gouzy, J., Bendahmane, M., 2012. Transcriptome database resource and gene expression atlas for the rose. *BMC Genomics.* 13, 638.

Evans, R.Y., Reid, M.S., 1986. Control of petal expansion during diurnal opening of roses. *Acta Hort.* 181, 55-63.

Evans, R.Y., Reid, M.S., 1988. Changes in carbohydrates and osmotic potential during rhythmic expansion of rose petals. *J. Amer. Soc. Hort. Sci.* 113, 884-888.

Fry, S.C., Smith, R.C., Renwick, K.F., Martin, D.J., Hodge, S.K., Matthews, K.J., 1992. Xyloglucan endotransglycosylase, a new wall-loosening enzyme activity from plants. *Biochem. J.* 282, 821-828.

Goetz, M., Godt, D.E., Guivarc'h, A., Kahmann, U., Chriqui, D., Roitsch, T., 2001. Induction of

male sterility in plants by metabolic engineering of the carbohydrate supply. *Proc. Natl. Acad. Sci.* 98, 6522-6527.

Godt, D.E., Roitsch, T., 1997. Regulation and tissue-specific distribution of mRNA for three extracellular invertase isoenzymes of tomato suggests an important function in establishing and maintaining sink metabolism. *Plant Physiol.* 115, 273-282.

Goetz, M., Godt, D.E., Roitsch, T., 2000. Tissue –specific induction of the mRNA for an extracellular isoenzyme of tomato by brassinosteroids suggests a role of steroid hormones in assimilate partitioning. *Plant J.* 22, 515-522.

Greiner, S., Koster, U., Lauer, K., Rosenkranz, H., Vogel, R., Rausch, T., 2000. Plant invertase inhibitors: expression in cell culture and during plant development. *Aust. J. Plant Physiol.* 27, 807-814.

Greiner, S., Krausgrill, S., Rausch, T., 1998. Cloning of a tobacco apoplasmic invertase inhibitor. Proof of function of the recombinant protein and expression analysis during plant development. *Plant Physiol.* 116, 733-742.

Halaba, J., Rudnicki, R.M., 1989. Invertase inhibitor in wilting flower petals. *Sci. Hort.* 40, 83-90.

- Halevy, A.H., Mayak, S., 1981. Senescence and postharvest physiology of cut flowers: Part2. Hort. Reviews. 3, 59-143.
- Hendel-Rahmanim, K., Masci, T., Vainstein, A., Weiss, D., 2007. Diurnal regulation of scent emission in rose flowers. *Planta* 226, 1491-1499.
- Ho, L.C., Nichols, R., 1977. Translocation of <sup>14</sup>C-sucrose in relation to changes in carbohydrate content in rose corollas cut at different stages of development. *Ann. Bot.* 41, 227-242.
- Hothorn, M., Van den Ende, W., Lammens, W., Rybin, V., Scheffzek, K., 2010. Structural insights into the pH-controlled targeting of plant cell-wall invertase by a specific inhibitor protein. *Proc. Natl. Acad. Sci.* 107, 17427-17432.
- Hughes, R.M., Vrana, J.D., Song, J., Tucker, C.L., 2012. Light-dependent, dark-promoted interaction between *Arabidopsis* cryptochrome 1 and phytochrome B proteins. *J. Biol. Chem.* 287, 22165-22172.
- Ichimura, K., Kawabata, Y., Kishimoto, M., Goto, R., Yamada, K., 2003. Shortage of soluble carbohydrates is largely responsible for short vase life of cut 'Sonia' rose flowers. *J. Jpn. Soc. Hort. Sci.* 72, 292-298.
- Ichimura, K., Kishimoto, M., Norikoshi, R., Kawabata, Y., Yamada, K., 2005.

Soluble carbohydrates and variation in vase-life of cut rose cultivars 'Delilah' and 'Sonia'. J. Hort. Sci. Biotechnol. 80, 280–286.

Ichimura, K., Shimizu-Yumoto, H., 2007. Extension of the vase life of cut roses by treatment with sucrose before and during simulated transport. Bull. Natl. Inst. Flor. Sci. 7, 17-27.

Ichimura, K., Suto, K., 1998. Environmental factors controlling flower opening and closing in a *Portulaca* hybrid. Ann. Bot. 82, 67-70.

Ishikawa, T., Nishio, J., Ichimura, K., 2006. Effects of light shielding treatment during cultivation on vase life and sugar content of cut chrysanthemum. Res. Bull. Aichi Agric. Res. Ctr. 38, 127-132.

Islam, M.S., Matsui, T., Yoshida, Y., 1996. Carbohydrate content and the activities of sucrose synthase, sucrose phosphate synthase and acid invertase in different tomato cultivars during fruit development. Sci. Hort. 65, 125-136.

Ji, X., Van den Ende, W., Van Laere, A., Cheng, S., Bennett, J., 2005. Structure, evolution, and expression of the two invertase gene families of rice. J. Mol. Evol. 60, 615-634.

- Johanson, U., Karlsson, M., Johansson, I., Gustavsson, S., Sjövall, S., Fraysse, L., Weig, A.R., Kjellbom, P., 2001. The complete set of genes encoding major intrinsic proteins in *Arabidopsis* provides a framework for a new nomenclature for major intrinsic proteins in plants. *Plant Physiol.* 126, 1358-69.
- Jones, M.B., Mansfield, T.A., 1975. Circadian rhythms in plants. *Sci. Prog. Oxford.* 62, 103-125.
- Kaihara, S., Takimoto, A., 1980. Studies on the light controlling the time of flower-opening in *Pharbitis nil*. *Plant Cell Physiol.* 21, 21-26.
- Kaihara, S., Takimoto, A., 1981a. Effects of light and temperature on flower-opening in *Pharbitis nil*. *Plant Cell Physiol.* 22, 215-221.
- Kaihara, S., Takimoto, A., 1981b. Physical basis of flower opening in *Pharbitis nil*. *Plant Cell Physiol.* 22, 307-310.
- Kato, M., Shimizu, H., Onozaki, T., Tanikawa, N., Ikeda, H., Hisamatsu, T., Ichimura, K., 2002. Role of ethylene in senescence of pollinated and unpollinated *Campanula medium*. *Flowers. J. Jpn. Soc. Hort. Sci.* 71, 385-387.
- Katsuhara, M., Hanba, T.Y., Shiratake, K., Maeshima, M., 2008. Expanding roles of plant aquaporins in plasma membranes and cell organelles. *Funct. Plant Biol.*

35, 1-14.

Kende, H., 1993. Ethylene biosynthesis. *Annu. Rev. Plant Physiol. Mol. Biol.* 44, 283-307.

Koch, K.E., 1996. Carbohydrate-modulated gene expression in plants. *Annu. Rev. Plant Physiol. Plant. Mol. Biol.* 47, 509-540.

Kohorn, B.D., Kobayashi, M., Johansen, S., Riese, J., Huang, L.F., Koch, K., Fu, S., Dotson, A., Byers, N., 2006. An *Arabidopsis* cell wall-associated kinase required for invertase activity and cell growth. *Plant J.* 46, 307-316.

Kumar, N., Srivastava, G.C., Dixit, K., Mahajan, A., Pal, M., 2007. Role of carbohydrates in flower bud opening in rose (*Rosa hybrida* L.). *J. Hort. Sci. Biotech.* 82, 235-242.

Lara, M., Encarnacion, B., Garcia, M.G., Fatima, T., Ehness, R., Lee, T.K., Proels, R., Tanner, W., Roitsch, T., 2004. Extracellular invertase is an essential component of cytokinin-mediated delay of senescence. *Plant Cell* 16, 1276-1287.

Li, Q.H., Yang, H.Q., 2007. Cryptochrome signaling in plants. *Photochem. Photobiol.* 83, 94-101.



- Linden, J.C., Ehness, R., Roitsch, T., 1996. Ethylene regulation of apoplastic invertase expression in autotrophic cells of *Chenopodium rubrum*. *Plant Growth Regulation* 19, 219-222.
- Lumsden, P.J., 1991. Circadian rhythms and phytochrome. *Annu. Rev. Plant. Physiol. Plant. Mol. Biol.* 42, 351-371.
- Ma, N., Xue, J., Li, Y., Liu, X., Dai, F., Jia, W., Luo, Y., Gao, J., 2008. Rh-PIP2;1, a rose aquaporin gene, is involved in ethylene-regulated petal expansion. *Plant Physiol.* 148, 894-907.
- Markhart, A.H. III, Harper, M.S., 1995. Deleterious effects of sucrose in preservative solutions on leaves of cut roses. *HortSci.* 30, 1429-1432.
- Maurel, C., 2007. Plant aquaporins: novel functions and regulation properties. *FEBS Lett.* 581, 2227-2236.
- Mishra, B.S., Singh, M., Aggrawal, P., Laxmi, A., 2009. Glucose and auxin signaling interaction in controlling *Arabidopsis thaliana* seedlings root growth and development . *PLoS One.* 4, e4502.
- Murray, M.G., Thompson, W.F., 1980. Rapid isolation of high-molecular-weight plant DNA. *Nucl. Acid. Res.* 8, 4321-4325.

- Nishitani, K., Tominaga, R., 1992. Endo-xyloglucan transferase, a novel class of glycosyltransferase that catalyzes transfer of a segment of xyloglucan molecule to another xyloglucan molecule. *J. Biol. Chem.* 267, 21058-21064.
- Onozaki, T., Yagi, M., Shibata, M., 2008. Selection of ethylene resistant carnation (*Dianthus caryophyllus* L.) by video recording system and their response to ethylene. *Sci. Hort.* 116, 205-212.
- Paul, B.D.H., Derbyshire, P., Findlay, K., Pike, M., Wellner, N., Lunn, J., Feil, R., Simpson, C., Maule, A. Smith, A.M., 2009. Normal growth of *Arabidopsis* requires cytosolic invertase but not sucrose synthase. *Proc. Natl. Acad. Sci.* 106, 13124-13129.
- Paulin, A., Jamain, C., 1982. Development of flowers and changes in various sugars during opening of cut carnations. *J. Amer. Soc. Hort. Sci.* 107, 258-261.
- Rausch, T., Greiner, S., 2004. Plant protein inhibitors of invertases. *Biochim. Biophys. Acta.* 1696, 253-61.
- Reca, I.B., Brutus, A., D'Avino, R., Villard, C., Bellincampi, D., Giardina, T., 2008. Molecular cloning, expression and characterization of a novel apoplastic invertase inhibitor from tomato (*Solanum lycopersicum*) and its use to purify a vacuolar invertase. *Biochimie.* 90, 1611-23.

- Remay, A., Lalanne, D., Thouroude, T., Le Couviour, F., Hibrand-Saint Oyant, L., Foucher, F., 2009. A survey of flowering genes reveals the role of gibberellins in floral control in rose. *Theor. Appl. Genet.* 119, 767–781.
- Roitsch, T., Balibrea, M.E., Hofmann, M., Proels, R., Sinha, A.K., 2003. Extracellular invertase: key metabolic enzyme and PR protein. *J. Exp. Bot.* 54, 513-524.
- Roitsch, T., Binyet, M., Godt, D.E., 1995. Induction of apoplastic invertase of *Chenopodium rubrum* by D-glucose and a glucose analog and tissue specific expression suggest a role in sink source regulation. *Plant Physiol.* 108, 285-294.
- Roitsch, T., González, M.C., 2004. Function and regulation of plant invertase: sweet sensations. *Trends Plant Sci.* 9, 606-613.
- Roitsch, T., Ludwig-Müller, J., 2011. Extracellular invertase is involved in the regulation of clubroot disease in *Arabidopsis thaliana*. *Mol. Plant Pathol.* 12, 247-262.
- Rolland, F., Moore, B., Sheen, J., 2002. Sugar sensing and signaling in plants. *Plant Cell* 14, 185-205.

- Ruan, Y.L., Llewellyn, D.J., Furbank, R.T., 2003. Suppression of sucrose synthase gene expression represses cotton fiber cell initiation, elongation, and seed development. *Plant Cell* 15, 952-64.
- Savin, K., Baudinette, S., Graham, M., Michael, M., Nugent, G., Lu, C., Chandler, S., Cornish, E., 1995. Antisense ACC oxidase RNA delays carnation petal senescence. *HortSci.* 30, 970-972.
- Sergeeva, L.I., Keurentjes, J.J., Bentsink, L., Vonk, J., van der Plas, L.H., Koornneef, M., Vreugdenhil, D., 2006. Vacuolar invertase regulates elongation of *Arabidopsis thaliana* roots as revealed by QTL and mutant analysis. *Proc. Natl. Acad. Sci.* 103, 2994-2999.
- Shimizu-Yumoto, H., 2009. Study on the postharvest life of *Eustoma grandiflorum* (Raf.) shininn. Cut flowers. *Bull. Natl. Inst. Flor. Sci.* 9, 91-135.
- Siemens, J., González, M.C., Wolf, S., Hofmann, C., Greiner, S., DU, Y., Rausch, T., 2011. Extracellular invertase is involved in the regulation of clubroot disease in *Arabidopsis thaliana*. *Mol. Plant. Pathol.* 12, 247-62.
- Smeekens, S., 2000. Sugar-induced signal transduction in plants. *Annu. Rev. Plant. Physiol. Plant. Mol. Biol.* 51, 49-81.

Somers, D.E., Devin, P.F., Kay, S.A., 1998. Phytochromes and cryptochromes in the entrainment of the *Arabidopsis* circadian clock. *Science* 282, 1488-1490.

Strurm, A., 1999. Invertases: primary structures, functions and roles in plant development and sucrose partitioning. *Plant Physiol.* 121, 1-7.

Strurm, A., Chrispeels, M.J., 1990. cDNA cloning of carrot extracellular  $\beta$ -fructocidase and its expression in response to wounding and bacterial infection. *Plant Cell* 2, 1107-1119.

Tang, G., Luscher, M., Sturm, A., 1999. Antisense repression of vacuolar and cell wall invertase in transgenic carrot alters early plant development and sucrose partitioning. *Plant Cell* 11, 177-189.

Thompson, J.D., Higgins, D.G., Gibson, T.J., 1994. CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, position-specific gap penalties and weight matrix choice. *Nucleic Acids Res.* 22, 4673-4680.

Tymowska-Lalanne, Z., Kreis, M., 1998a. Expression of the *Arabidopsis thaliana*

invertase gene family. *Planta* 207, 259-265.

Tymowska-Lalanne, Z., Kreis, M., 1998b. The plant invertases: Physiology, biochemistry and molecular biology. *Advances in Botanical Research* 28, 71-117

Trouberie, J., Chateau-Joubert, S., Thevenot, C., Jacquemot, M.P., Prioul, J.L., 2004. Regulation of vacuolar invertase by abscisic acid or glucose in leaves and roots from maize plantlets. *Planta* 219, 894-905.

van Doorn, W.G., van Meeteren, U., 2003. Flower opening and closure: a review. *J. Exp. Bot.* 54, 1801-1812.

van Doorn, W.G., Groenewegen, G., van de Pol P.A., Berkholst, C.E.M., 1991. Effects of carbohydrate and water status on flower opening of cut 'Madelon' roses. *Postharvest Biol. Technol.* 1, 47-57.

Vagas, W., Cumino, A., Salerno, G.L., 2003. Cyanobacterial alkaline/neutral invertases: origin of sucrose hydrolysis in the plant cytosol. *Planta* 216, 951-960.

Weber, H., Borisjuk, L., and Wobus, U., 1996. Controlling seed development and seed size in *Vicia faba*: a role for seed coat-associated invertases and carbohydrate state. *Plant J.* 10, 823-834.

- Weil, M., Krausgrill, A., Schuster, T., Rausch, A., 1994. A 17-kDa *Nicotiana tabacum* cell-wall peptide acts as an in-vitro inhibitor of the cell-wall isoform of acid invertase. *Planta* 193, 438-445.
- Weil, M., Rausch, T., 1990. Cell wall invertase in tobacco crown gall cells. *Plant Physiol.* 94, 1575-1581.
- Winkenbach, F., 1971. Zum Stoffwechsel der aufblühenden und welkenden Korolle der Prunkwinde *Ipomoea purpurea*. I. Beziehungen zwischen Gestaltwandel, Stofftransport, Atmung und Invertase-aktivität. *Berichte der Schweizerischen Botanischen Gesellschaft* 80, 374-390.
- Wu, M.J., Zakaris, L., Reid, M.S., 1991. Variation in the senescence of carnation (*Dianthus caryophyllus* L.) cultivars. II. Comparison of sensitivity to exogenous ethylene and of ethylene binding. *Sci. Hort.* 48, 99-107.
- Wu, L-L., Michael, J.P., Cohn, N.S., Kaufman, P.B., 1993. Gibberellin (GA<sub>3</sub>) enhances cell wall invertase activity and mRNA levels in elongating dwarf pea (*Pisum sativum*) shoots. *International Journal of Plant Sciences* 154, 280-289.
- Xiaopeng, P., Wu, Z.C., Li, J.H., Mo, X.R., Wu, S.H., Chu, J., Wu, P., 2007. AtCYT-INV1, a neutral invertase, is involved in osmotic stress-induced

- inhibition on lateral root growth in *Arabidopsis*. *Plant Mol. Biol.* 64, 575-587.
- Xue, J., Yang, F., Gao, J., 2009. Isolation of *Rh-TIP1;1*, an aquaporin gene and its expression in rose flowers in response to ethylene and water deficit. *Postharvest Biol. Technol.* 51, 407-413.
- Yamaki, S., Ino, M., 1992. Alteration of cellular compartmentation and membrane—permeability to sugars in immature and mature apple fruit. *J. Amer. Soc. Hort. Sci.* 117, 951-954.
- Yamada, K., Ito, M., Oyama, T., Nakada, M., Maesaka, M., Yamaki, S., 2007a. Analysis of sucrose metabolism during petal growth of cut roses. *Postharvest Biol. Technol.* 43, 174-177.
- Yamada, K., Kojima, T., Bantog, A.B., Shimoda, T., Mori, H., Shiratake, K., Yamaki, S., 2007b. Cloning of two isoforms of soluble acid invertase of Japanese pear and their expression during fruit development. *J. Plant Physiol.* 164, 746-755.
- Yamada, K., Norikoshi, R., Suzuki, K., Imanishi, H., Ichimura, K., 2009a. Determination of subcellular concentrations of soluble carbohydrates in rose petals during opening by nonaqueous fractionation method combined with infiltration-centrifugation method. *Planta* 230, 1115-1127.



- Yamada, K., Takahashi, R., Fujitani, C., Mishima, K., Yoshida, M., Daryl, C. J., Yamaki, S., 2009b. Cell wall extensibility and effect of cell-wall-loosening proteins during rose flower opening. *J. Jpn. Soc. Hort. Sci.* 78, 242-251.
- Yang, S.F., Hoffman, N.E., 1984. Ethylene biosynthesis and its regulation in higher plant. *Annu. Rev. Plant Physiol.* 35, 155-189.
- Zakizadeh, H., Lütken, H., Sriskandarajah, S., Serek, M., Müller, R., 2013. Transformation of miniature potted rose (*Rosa hybrida* cv. Linda) with P<sub>SAG12</sub>-ipt gene delays leaf senescence and enhances resistance to exogenous ethylene. *Plant Cell Rep.* 32, 195-205.
- Zhang, X.Y., Wang, X.L., Wang, X.F., Xia, G.H., Pan, Q.H., Fan, R.C., Wu, F.Q., Yu, X.C., Zhang, D.P., 2006. A shift of phloem unloading from symplasmic to apoplasmin pathway is involved in developmental onset of ripening in grape berry. *Plant Physiol.* 142, 220-232.
- 市村一雄 (2000) 切り花の鮮度保持 筑波書房.
- 伊藤真和 (2008) 切りバラ花卉の展開におけるインベルターゼの役割. 名古屋大学大学院生命農学研究科 修士論文
- 上田善弘 (2007) 特別展 花 朝日新聞社 pp, 116-119.

落合正樹 (2012) トルコギキョウの開花における細胞壁伸展性関連タンパク質の機能とその制御. 名古屋大学大学院生命農学研究科 博士論文

大山暁男 (2000) トマト (*Lycopersicon esculentum* Mill.) 酸性インベルターゼの生理機能に関する研究. 野菜・茶業試験場研究報告. 15, 17-62.

花き産業振興方針検討会 (2009) 花き産業振興方針 (中間とりまとめ). 農林水産省

金山喜則, 山木昭平 (1993) 果実が甘くなるしくみ. 化学と生物. 31, 578-586.

小島拓也 (2005) ニホンナシ果実における液胞型インベルターゼの発現解析. 名古屋大学農学部資源生物環境学科 卒業論文

高橋励 (2008) バラ花卉の細胞肥大成長におけるエクспанシンの役割. 名古屋大学大学院生命農学研究科 修士論文

藤谷千春 (2008) バラ花卉の展開におけるエンド型キシログルカン転移酵素/加水分解酵素の役割. 名古屋大学大学院生命農学研究科 修士論文

中田麻衣子 (2004) バラ花卉中の糖代謝酵素の働き. 名古屋大学農学部資源生物環境学科 卒業論文

農林水産統計 (2012) 農林水産省大臣官房統計部 平成 24 年産花きの作付 (収穫) 面積  
及び出荷量

山根健治, 河鱒実之, 崎山亮三 (1991) グラジオラス花被の生長に伴う水分生理, 炭水  
化物量および酸性インベルターゼ活性の変化. 園芸学会雑誌. 60, 421-428.