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Short communication

Sequence of the Wound-responsive Lipoxygenase Gene from Maize Seedlings

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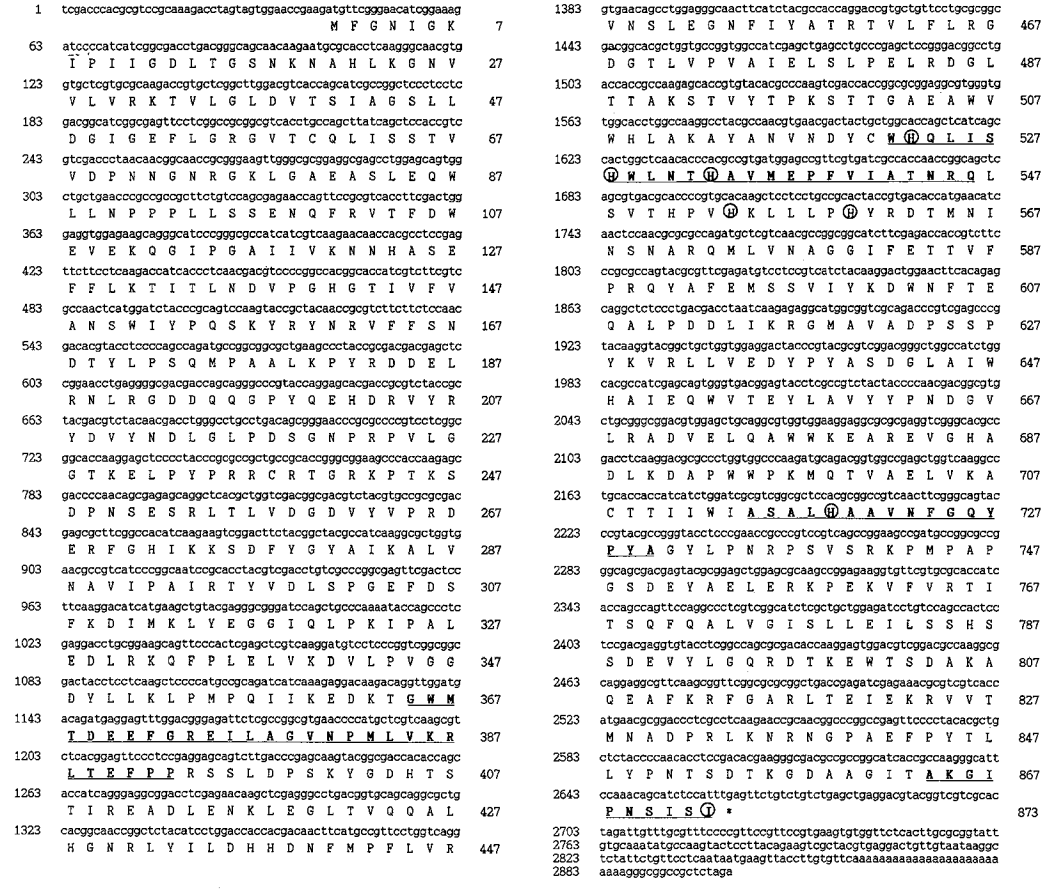

Fig. 1. Nucleotide and deduced amino acid sequence of *Zea mays* Lox cDNA. Highly conserved regions are underlined. Six His residues, and one Ile residue, that are involved in binding the iron atom are circled. Poly(A+) signals are in bold face type.

Keywords: Lipoxygenase, Jasmonic acid, Wound

Lipoxygenases (EC 1.13.11.12; *Lox*) are non-hem iron-containing dioxygenases that catalyze the hydroperoxidation of polyunsaturated fatty acids, which have a cis, cis-1,4-pentadiene structure. The products of Lox enzymes, hydroperoxy fatty acids, are further metabolized into a number of biologically active compounds (Hildebrand *et al.*, 1988). In plants, Lox enzymes catalyze a conversion of

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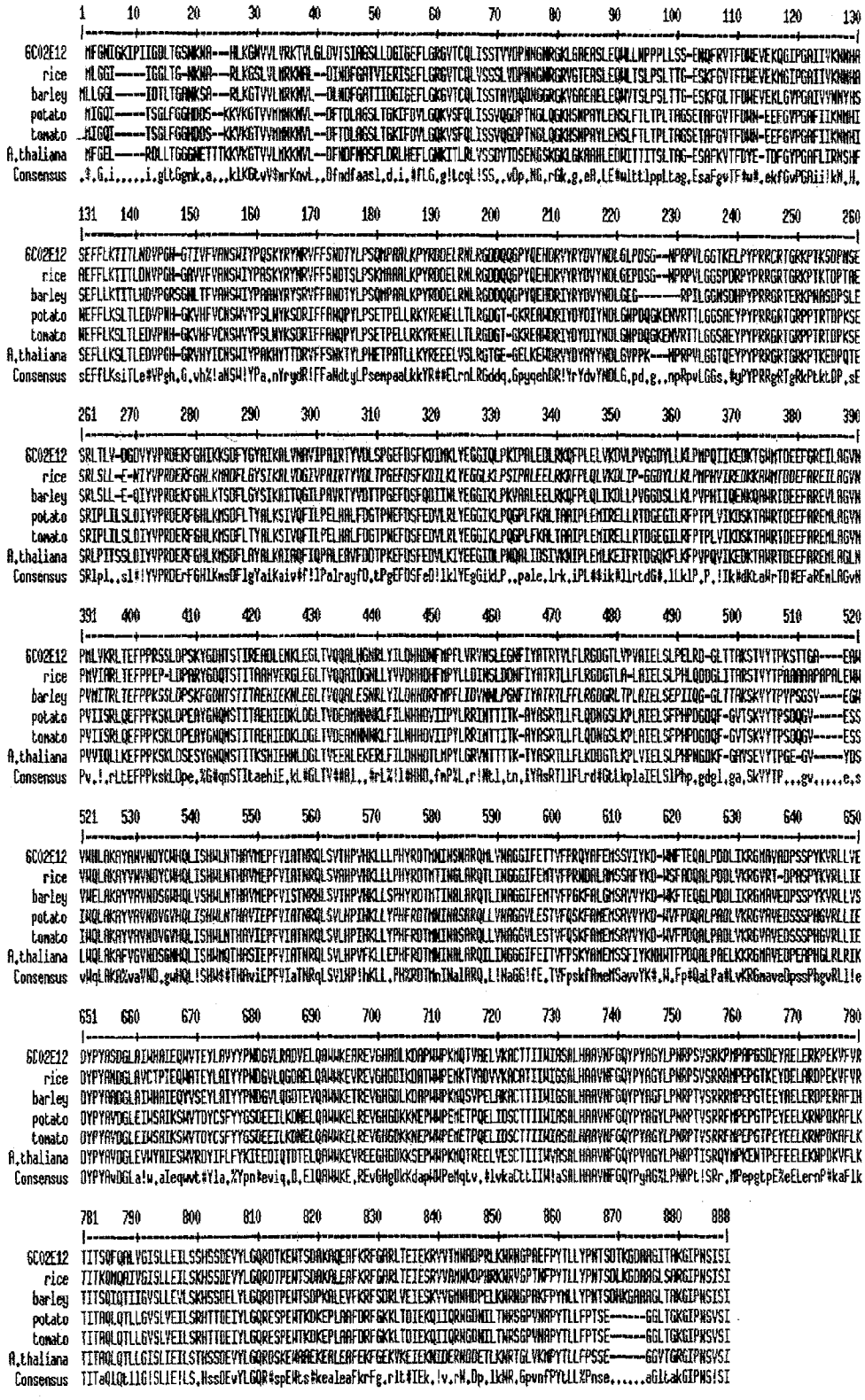

Fig. 2. Alignment of the deduced amino acid sequences of *Zea mays* Lox and other plant Lox proteins. 6CO2E12; *Zea mays*, AF 271894, rice; L-2, X64396, barley; Lox-1, L35931, potato; X79107, tomato; U09026, *A.thaliana*; Lox1, L04637, Gaps (-) were introduced to maximize alignment, i; anyone of I, V, $; anyone of L, M, %; anyone of F, Y, #; anyone of N, D, Q, E, Z.

linoleic acid or linolenic acid into corresponding hydroperoxy derivatives. Accumulated evidence indicates that Lox enzymes participate in senescence and the response to pathogens, wounding and plant growth regulators, such as

jasmonic acid (Vick and Zimmerman, 1987; Siedow, 1991) and abscisic acid (Creelman *et al.*, 1992). Jasmonic acid and/or methyl jasmonate has been proposed to play a role in the response to pathogens and wounding by inducing the expression of several genes (Farmer and Ryan, 1992; Reinbothe *et al.*, 1994), including proteinase inhibitors, vegetative storage proteins, and Lox enzymes. These results suggest that the regulation of the Lox gene expression is controlled by jasmonic acid, and may be an important step in providing putative octadecanoid signaling molecules for the response to stress in plants. A number of Lox enzymes have been identified in various plants (Siedow, 1991), including maize (Jensen *et al.*, 1997). Several *Lox* genes have been isolated and characterized.

In an effort to clarify the effect of methyl jasmonate on the *Lox* gene expression, the GenBank database was searched for maize *Lox* sequences; this resulted in three putative *Lox* clones from the University of Missouri-Columbia Clone Distribution Center. Total RNA was prepared from wounded maize seedlings and hybridized with each of three putative 1.3 kb *Lox* gene fragments as a probe. Only one {pZL1/LOX(6C02E12)} of the three *Lox* genes strongly hybridized with total RNA prepared from wounded maize seedlings. The induction of the 6CO2E12 *Lox* gene expression by methyl jasmonate was also confirmed. The 6CO2E12 clone was sequenced (Fig. 1) and registered in the GenBank (Accession no. AF271894). The *Lox* gene consisted of 2,622 nucleotides encoding a polypeptide of 873 amino acids with a calculated molecular mass of 96 kDa. The deduced amino acid sequence (Fig. 2) of the gene contained four representative conserved regions of Lox. Six histidines, and one isoleucine that is known to be responsible for iron binding, were also found. The amino acid sequence showed from a 75% to 52% identity with those of the *Lox1* gene family, and represented the highest sequence homology with rice Lox (L-2), exhibiting a 75% identity. On the basis of the sequence homology, the *Lox* gene was classified as a member of the *Lox1* gene family.

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References

Bell, E. and Mullet, J. E. (1993) Characterization of an *Arabidopsis lipoxygenase* gene responsive to methyl jasmonate and wounding. *Plant Physiol.* **103**, 1133-1137.

Creelman, R. A., Bell, E. and Mullet J. E. (1992) Jasmonic acid/methyl jasmonate accumulate in wounded soybean hypocotyls and modulate wound gene expression. *Plant Physiol.* **99**, 1258-1260.

Farmer, E. E. and Ryan C. A. (1992) Octadecanoid precursors of jasmonic acid activates the synthesis of wound-inducible proteinase inhibitors. *Plant Cell* **4**, 129-134.

Hildebrand, D. F., Hamilton-Kemp, T. R., Legg, C. S. and Bookjans, G. (1988) Plant lipoxygenase: Occurrence, properties and possible functions. *Plant Biochem. Physiol.* **7**, 201-219.

Jensen, A. B., Poca, E., Rigaud M, Freyssinet G and Pages M. (1997) Molecular characterization of L2 lipoxygenase from maize embryos. *Plant Mol. Biol.* **33**, 605-614.

Mechelen, J. R., Smits, M., Douma, A. C., Rouster, J., Cameron-Mills, V., Heidekamp, F. and Valk, B. E. (1995) Primary structure of a lipoxygenase from barley grain as deduced from its cDNA sequence. *Biochim. Biophys. Acta* **1254**, 221-225.

Peng, Y. -L., Shirano, Y., Ohta, H., Hibino, T., Tanaka, K. and Shibata, D. (1994) A novel lipoxygenase from rice. *J. Biol. Chem.* **269**, 3755-3761.

Reinbothe, S, Mollenhauer, B. and Reinbothe, C. (1994) JIPs and RIPs: The regulation of plant gene expression by jasmonates in response to environmental cues and pathogenes. *Plant Cell* **6**, 1197-1209.

Royo, J., Vancanneyts, G., Perez, A. G., Sanz, C., Stormann, K., Rosahl, S. and Sanchez-Serrano, J. J. (1996) Characterization of three potato lipoxygenases with distinct enzymatic activities and different organ-specific and wound-regulated expression patterns. *J. Biol. Chem.* **271**, 21012-21019.

Shibata, D. and Axelrod, B. (1995) Plant lipoxygenases. *J. Lipid Mediators Cell Signal.* **12**, 213-228.

Siedow J. N. (1991) Plant lipoxygenases: structure and function. *Annu. Rev. Plant Physiol. Plant Mol. Biol.* **42**, 145-188.

Vick, B. A. and Zimmerman, D. C. (1987) Oxidative systems for modification of fatty acids in the lipoxygenase pathway in *The Biochemistry of Plants*, Stunpf, P. K. (ed.), Academic Press, NY, pp. 53-90.