AS> Vol.3 No.8, December 2012

OPEN ACCESS

Research on the allelopathic potential of wheat

PDF (Size:143KB) PP. 979-985 DOI: 10.4236/as.2012.38119

Author(s)

Yau Lam, Cho Wing Sze, Yao Tong, Tzi Bun Ng, Tang Chi Wai, Ho Chung Wen, Qiaoqing Xiang, Xiao Lin, Yanbo Zhang

ABSTRACT

Objective: This paper mainly discusses the Allelopathic potential of Wheat. Methods: This paper is prepared by reviewing the latest academic literatures. Result: The green revolution in the 1960s caused an increase in the demand for food. The agricultural sector and farmers tended to spend more time on the agricultural work but the crop yield was suppressed by the weeds. Hence, the usage of herbicide insecticides, fungicides and others chemicals had been increased. Although herbicides are efficient for weed controls, the continuous uses had gradually stimulated the weeds developing an effecttive resistance to the chemicals. Wheat (*Triticum aestivum L.*) is known as allelopathic against crops and weeds. Allelopathy of wheat (*Triticum aestivum L.*) has been extensively examined for its potentials in weeds management. The allelopathic activity of wheat has been attributed to hydroxamic acids, the related compounds and phenolic acids. Therefore, it could effectively reduce herbicide uses in order to maintain an eco-friendly environment and a cost-effective weed control.

KEYWORDS

Wheat; Allelopathic Effect; Allelopathic Crop; Straw; Stubble; Benzoxazinones; Phenolics

Cite this paper

Lam, Y. , Sze, C. , Tong, Y. , Ng, T. , Wai, T. , Wen, H. , Xiang, Q. , Lin, X. and Zhang, Y. (2012) Research on the allelopathic potential of wheat. *Agricultural Sciences*, 3, 979-985. doi: 10.4236/as.2012.38119.

References

[1] Lemerle, D., Verbeek, B. and Orchard, B. (2001) Ranking the ability of wheat varieties to compete with Lolium rigidum. Weed Research, 41, 197-209. doi:10.1046/j.1365-3180.2001.00232.x

[2] Fishel, F.M. (2007) Pesticide use trends in the US: Global comparison. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville.

[3] Ronal, D.E. (2000) Hand book of chemical risk assessment: Health hazards to humans, plants and animals, Vol. II. Lewis Publishers, Washington DC.

[4] Macias, F.A., Molinillo, J.M.G., Varela, R.M. and Galindo, J.C.G. (2007) Allelopathy—A natural alternative for weed control. Pest Management Science, 63, 327-348. doi:10.1002/ps.1342

[5] Jamil, M., Cheema, Z.A., Mushtaq, M.N., Farooq, M. and Cheema, M.A. (2009) Alternative control of wild oat and canary grass in wheat fields by allelopathic plant water extracts. Agronomy for Sustainable Development, 29, 475-482. doi:10.1051/agro/2009007

[6] Zeng, R.S., Mallik, A.U. and Luo, S.M. (2008) Allelopathy in forested ecosystems. In: Zeng, R.S., Mallik, A.U. and Luo, S.M., Eds., Allelopathy in Sustainable Agriculture and Forestry, Springer, New York, 363-377.

[7] Yongqing, M.A. (2005) Allelopathic studies of common wheat (Triticum aestivum L.). Weed Biology and Management, 5, 93-104. doi:10.1111/j.1445-6664.2005.00164.x

[8] Bertholdsson, N.O. (2005) Early vigour and allelopathy—Two useful traits for enhanced barley and wheat competitiveness with weeds. Weed Research, 45, 94-102. doi:10.1111/j.1365-

3180.2004.00442.x

[9] Villagrasa, M., Guillamon, M., Labandeira, A., Taberner, A., Eljarrat, E. and Barcelo, D. (2006) Benzoxazinoid allelochemicals in wheat: Distribution among foliage, roots, and seeds. Journal of Agricultural and Food Chemistry, 54, 1009-1015. doi:10.1021/jf050898h

[10] Narwal, S.S.M.K., Sarmah, J.C. and Tamak (1998) Allelopathic strategies for wheat management in rice wheat rotation in northwestern India. In: Olofsdotter, M., Ed., Allelopathy in Rice. Proceedings of the Workshop on Allelopathy in Rice, 117-131.

[11] Ma, R.X., Liu, X.F., Yuan, G.L. and Sun, S.E. (1997) Study on the allelochemicals produced by bacteria and fungi in rhizosphere and their bioactivity. Acta Ecologica Sinica, 17, 449-452.

[12] Steinsiek, J.W., Oliver, L.R. and Collins, F.C. (1982) Allelopathic potential of wheat (Triticum aestivum) straw on selected weed species. Weed Science Society of America, 30, 495-497.

[13] Hiroshi N, Satoshi, M., Hideyuki, S. and Koji, H. (2006) Plant growth inhibitory compounds from aqueous leachate of wheat straw. Plant Growth Regulation, 48, 215-219.

[14] Ma, R.X., Liu, X.F., Yuan, G.L. and Sun, S.E. (1996) Study on allelochemicals in the process of decomposition of wheat straw by microorganisms and their bioactivity. Acta Ecologica Sinica, 16, 632-639.

[15] Chan, K.Y. and Pratley, J.E. (1998) Soil structural decline —Can the trend be reversed? In: Pratley, J.E. and Roberston, A., Eds., Agriculture and the Environmental Imperative, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Melbourne, 129-163.

[16] Blum, U., King, L.D. and Brownie, C. (2002) Effects of wheat residues on dicotyledonous weed emergence in a simulated no-till system. Allelopathy Journal, 9, 159-176.

[17] Zuo, S.P., Ma, Y.Q. and Inanaga, S. (2008) Ecological adaptation of weed biodiversity to the allelopathic rank of the stubble of different wheat genotypes in a maize field. Weed Biology and Management, 8, 161-171. doi:10.1111/j.1445-6664.2008.00292.x

[18] Lyon, D., Bruce, S.E., Vyn, T. and Peterson, G. (2004) Global (USA & Australian experiences) achievements and future challenges in conservation tillage. New Directions for a Diverse Planet: Proceedings of the 4th International Crop Science Congress, Brisbane, Australia.

[19] Bruce, S.E., Kirkegaard, J.A., Pratley, J. and Howe, G. (2005) Impacts of retained wheat stubble on canola in southern NSW. Australian Journal of Agricultural Research, 45, 1-12.

[20] Bruce, S.E., Kirkegaard, J.A., Pratley, J. and G, Howe. (2006) Growth suppression of canola through wheat stubble I. Separating physical and biochemical causes in the field. Plant and Soil, 281, 203-218. doi:10.1007/s11104-005-4251-7

[21] Bruce, S.E., Ryan, M.H., Hely, S., Kirkegaard, J.A. and Pratley, J.E. (2006) Causes of growth suppression of canola through wheat stubble II. Investigating impacts of hypocotyl elongation using simulated stubble. Plant and Soil, 281, 219-231. doi:10.1007/s11104-005-4643-8

[22] Wu, H. et al. (2001) Allelochemicals in wheat (Triticum aestivum L.): Variation of phenolic acids in shoot tissues. Journal of Chemical Ecology, 27, 125-135. doi:10.1023/A:1005676218582

[23] Rice, E.L. (1984) Allelopathy. 2nd Edition, Academic Press, London, 309-316.

[24] Duke, S.O. and Dyan, F.E. (2006) Mode of action of phytotoxins from plants. In: Reigosa, M.J., Pedrol, N. and Gonzalez, L., Eds., Allelopathy: A Physiological Process with Ecological Implications, Springer, Netherlands, 511- 536.

[25] Bogatwk, R. and Gniazdowska, A. (2007) ROS and phytohormones in plant-plant allelopathic interactions. Plant Signaling Behavior, 2, 317-318. doi:10.4161/psb.2.4.4116

[26] Lyon, T.L. and Wilson, J.K. (1921) Liberation of organic matter by roots of growing plants. New York State Agricultural Experiment Station—Cornell University, 40, 44 p.

[27] Rovira, A.D. (1969) Plant root exudates. Botanical Review, 35, 35 – 59. doi:10.1007/BF02859887

[28] Preston, W.H., Mitchell, J.W. and Reevf, W. (1954) Movement of alpha-methoxyphenylacetic acid from one plant to another through their root systems. Science, 119, 437-438. doi:10.1126/science.119.3092.437

[29] Khaliq, A., Matloob, A., Aslam, F. and BismllahI, K.M. (2011) Influence of wheat straw and rhizosphere on seed germination, early seeding growth and bio-chemical attributes of Trianthema portulacastrum. Planta Daninha, 29, 523-533. doi:10.1590/S0100-83582011000300006

[30] Norman, A., Abood, L.A.S., Daniel, L., Flynn, K.A. Houseman, A.J., Wittwer, Vickie, M., Dilworth, Paul, J., Hippenmeyer, Barry, C. and Holwerda. (1997) Inhibition of human cytomegalovirus protease by benzoxazinones and evidence of antiviral activity in cell culture. Bioorganic & Medicinal Chemistry Letters, 7, 2105-2108. doi:10.1016/S0960-894X(97)00368-5

[31] Zhiqun, H., Terry, H., Hanwen, W.U., Min, A.N. and Jim, P. (2003) Correlation orrelation between phytotoxicity on annual ryegrass (Lolium rigidum) and production dynamics of allelochemicals within root exudates of an allelopathic wheat. Journal of Chemical Ecology, 29, 2263-2279.

[32] Rizvi, S.J.H. and Rizvi, V. (1992) Exploitation of allelochemicals in improving crop productivity. In: Rizvi, S.J.H. and Rizvi, V., Eds., Allelopthy: Basic and Applied Aspects, Chapman & Hall, London, 443-472.

[33] Batish, D.R., Singh, J.K., Pandher, V., Arora and Kohli, R.K. (2002) Phytotoxic effect of Parthenium residues on the growth of radish and chickpea and selected soil properties. Weed Biology and Management, 2, 73-78. doi:10.1046/j.1445-6664.2002.00050.x

[34] Batish, D.R., Tung, P., Singh, H.P. and Kohli, R.K. (2002) Phytotoxicity of sunflower residues against some summer season crops. Journal of Agronomy and Crop Science, 188, 19-24. doi:10.1046/j.1439-037x.2002.00526.x

[35] Liebl, R.A. and Worsham, A.D. (1983) Inhibition of pitted morning glory (Ipomoea lacunosa L.) and certain other weed species by phytotoxic compounds of wheat (Triticum aestivum L.) straw. Journal of Chemical Ecology, 9, 1027-1043. doi:10.1007/BF00982209

[36] Zhou, X.G., Zhang, Z.B. and Xu, P. (2005) Discussion of main breeding goals in wheat based on greysystems method (with English abstract in Chinese). System Sciences and Comprehensive Studies in Agriculture, 21, 81-84.

[37] Zuo, Y.Q. and Ma, S. (2007) Inanaga. Allelopathy variation in dryland winter wheat (Triticum aestivum L.) accessions grown on the Loess. Plateau of China for about fifty years. Genetic Resources and Crop Evolution, 54, 1381-1393. doi:10.1007/s10722-006-9123-3

[38] Watt, M., Kirkegaard, J.A. and Rebetzke, G.J. (2005) A wheat genotype developed for rapid leaf growth copes well with the physical and biological constraints of unplowed soil. Functional Plant Biology, 32, 695-706. doi:10.1071/FP05026

[39] Olofsdotter, M. (2001) Getting closer to breeding for competitive ability and the role of allelopathy—An example from rice (Oryza sativa). Weed Technology, 15, 798-806. doi:10.1614/0890-037X(2001)015[0798:GCTBFC]2.0.CO;2

[40] Rabinovich, S.V. (1998) Importance of wheat-rye translocations for breeding modern cultivars of Triticum aestivum L. Euphytica, 100, 323-340. doi:10.1023/A:1018361819215

[41] Bertholdsson, N.O. (2010) Breeding spring wheat for improved allelopathic potential. Weed Research, 50, 49-57. doi:10.1111/j.1365-3180.2009.00754.x

[42] Sharma, S., Bhat, P.R., Ehdaie, B., Close, T.J., Lukaszewski, A.J. and Waines, J.G. (2009) Integrated genetic map and genetic analysis of a region associated with root traits on the short arm of rye chromosome 1 in bread wheat. Theoretical and Applied Genetics, 119, 783-793. doi:10.1007/s00122-009-1088-0

[43] Putnam, A.R. (1985) Allelopathic research in agriculture: Past highlights and potential. In: Thompson, A.C. Ed., The Chemistry of Allelopathy: Biochemical Interactions among Plants, American Chemical Society, Washington, DC, 1-8. doi:10.1021/bk-1985-0268.ch001

[44] Ben, H.M., Ghorbal, M.H., Kremer, R.J. and Oueslati, O. (2002) Autotoxicity of barley. Journal of Plant Nutrition, 25, 1155-1161. doi:10.1081/PLN-120004379

[45] Yu, J.Q., Sen, S., Ya, Q., Zhu, Z. and Wen, H. (2000) Autotoxic potential of cucurbit crops. Plant and Soil, 223, 147-151. doi:10.1023/A:1004829512147

[46] Wu H.W., Jim, P., Deirdre, L. and De, L.L. (2007) Autotoxicity of wheat (Triticum aestivum L.) as determined by laboratory bioassays. Plant and Soil, 296, 85-93. doi:10.1007/s11104-007-9292-7

[47] Alam, S.M. (1990) Effect of wheat straw extract on the germination and seedling growth of wheat (cv. Pavon). Wheat Information Service, 71, 16-18.

[48] Protic, R., Andelic, M. and Vasiljevic, L. (1980) Anatomical structure and function of the root system of wheat as dependent on allelopathic effects. Savremena Poljoprivreda, 28, 243-256.

[49] Hicks, S.K., Wendt, C.W., Gannaway, J.R. and Baker, R.B. (1989) Allelopathic effects of wheat straw on cotton germination, emergence, and yield. Crop Science, 29, 1057-1061. doi:10.2135/cropsci1989.0011183X002900040048x

[50] Narwal, S.S., Sarmah, M.K. and Nandal, D.P. (1997) Allelopathic effects of wheat residues on growth and yield of fodder crops. Allelopathy, 4, 111-120.

[51] Khaliq, A., Aslam, Z. and Cheema, Z.A. (2002) Efficacy of different weed management strategies in mungbean (Vigna Radiata L.). International Journal of Agriculture and Biology, 4, 237-239.

[52] Iqbal, J., Cheema, Z.A. and Mushtaq, M.N. (2009) Allelopathic crop water extracts reduced the herbicide dose for weed control in cotton (Gossypium hirsutum L.). International Journal of Agriculture and Biology, 11, 360- 366.

[53] Netzly, D.H. and Butler, L.G. (1986) Roots of sorghum exude hydrophobic droplets containing biologically active components. Crop Science, 26, 775-780. doi:10.2135/cropsci1986.0011183X002600040031x

[54] Cheema, Z.A., Mushtaq, M.N., Farooq, M., Hussain, A. and Din, I.U. (2009) Purple nutsedge management with allelopathic sorghum. Allelopathy Journal, 23, 305-312.

[55] Wilson, R.E. and Rice, E.L. (1968) Allelopathy as expressed by Helianthus annuus and its roleinoldfield succession. Bulletin of the Torrey Botanical Club, 95, 432-448. doi:10.2307/2483475

[56] Macias, F.A., Varela, R.M., Torres, A., Oliva, R.M. and Molinillo, J.M.G. (1998) Bioactive norsesquiterpenes from Helianthus annuus with potential allelopathic activity. Phytochemistry, 48, 631-636. doi:10.1016/S0031-9422(97)00995-3