

Krisan Unggul
ScienceDirect 2005

Allelopathic activity of luteolin 7-O-[beta]-glucuronide isolated from *Chrysanthemum morifolium* L./Clifford W. Beninger, J. Christopher Hall, ***Biochemical Systematics and Ecology***, Volume 33, Issue 2, February 2005, Pages 103-111, ISSN 0305-1978, DOI: 10.1016/j.bse.2004.06.016.
(<http://www.sciencedirect.com/science/article/pii/S030519780400198X>)

Abstract:

Two flavones, luteolin 7-O-[beta]-glucuronide and diosmetin 7-O-[beta]-glucuronide, were isolated and identified from *Chrysanthemum morifolium* L. v. *Ramat* leaves. Identification techniques included HPLC DAD, MS, ¹H and ¹³C NMR spectroscopy. At concentrations of 0.2 and 2.0 mM, luteolin 7-O-[beta]-glucuronide significantly reduced the frond number and chlorophyll content of *Lemna gibba* plants, but did not significantly affect dry weight. At a concentration of 0.2 mM diosmetin 7-O-[beta]-glucuronide had no significant effect on frond number, dry weight or chlorophyll concentration of *L. gibba*. These results indicate that an ortho-3',4'-dihydroxy arrangement of the B-flavonoid ring in the luteolin compound is probably responsible for allelopathic activity.

Keywords: *Chrysanthemum morifolium*; Allelopathy; Flavonoids; Flavones; *Lemna gibba*

Quantification over time of chrysanthemum yellows phytoplasma (16Sr-I) in leaves and roots of the host plant *Chrysanthemum carinatum* (Schousboe) following inoculation with its insect vector/P. Saracco, D. Bosco, F. Veratti, C. Marzachi

Physiological and Molecular Plant Pathology, Volume 67, Issues 3-5, September 2005-October 2006, Pages 212-219, ISSN 0885-5765, DOI: 10.1016/j.pmp.2006.02.001.

(<http://www.sciencedirect.com/science/article/pii/S0885576506000099>)

Abstract:

The rate of increase of chrysanthemum yellows phytoplasma (CYP, 16Sr-I) in leaves and roots of the host plant *Chrysanthemum carinatum* following localised and free insect inoculation is described. The fate of CYP in each test plant has been monitored over time using a relative quantification method based on real time PCR. Significant differences in CYP titre have been found both in apical leaves and roots sampled at different times post inoculation. CYP was much more concentrated in young apical leaves and roots compared to old basal leaves. Few thousands and few hundred thousands CYP genome units per nanogram of plant DNA were the maximum amounts found in leaves and roots, respectively. Active movement of CYP towards young developing leaves and roots has been demonstrated.

Keywords: *Chrysanthemum yellows phytoplasma*; *Chrysanthemum carinatum*; *Macrosteles quadripunctulatus*; Quantitative real-time PCR; Multiplication; Movement

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Inclusion of a daisy plant (*Chrysanthemum coronarium*) in dairy sheep diet. 1: Effect on milk and cheese fatty acid composition with

particular reference to C18:2 cis-9, trans-11/A. Cabiddu, M. Addis, G. Pinna, S. Spada, M. Fiori, M. Sitzia, A. Pirisi, G. Piredda, G. Molle, **Livestock Science**, Volume 101, Issues 1-3, May 2006, Pages 57-67, ISSN 1871-1413, DOI: 10.1016/j.livprodsci.2005.09.014.

(<http://www.sciencedirect.com/science/article/pii/S030162260500388X>)

Abstract:

An experiment was carried out to evaluate the effect on milk and cheese fatty acid composition of the inclusion of *Chrysanthemum coronarium* L., (Asteracea) into dairy sheep diet. Plots sown either with a binary mixture consisting of *Lolium rigidum* Gaudin and *Medicago polymorpha* (LM) or a ternary mixture including the above species and *C. coronarium* were (LMC) grazed by groups of Sarda dairy ewes during May. The botanical composition of diet, as measured by n-alkane method, showed that 34% of LMC group diet consisted of *Chrysanthemum* flowers and leaves. Exposure of sheep to this non-conventional forage did not affect animal performance and milk composition (fat and casein, $P > 0.05$) but resulted in different milk and cheese fatty acid composition. In particular conjugated linoleic acid, vaccenic acid and linoleic acid were all higher in LMC than LM groups ($P < 0.05$). The probable main reason was the higher proportion of linoleic acid in *Chrysanthemum* forage and hence in LMC than LM diet.

Keywords: Milk fat; Fatty acids; CLA; Pasture; Sheep; *Chrysanthemum coronarium*

Quantification over time of chrysanthemum yellows phytoplasma (16Sr-I) in leaves and roots of the host plant *Chrysanthemum carinatum* (Schousboe) following inoculation with its insect vector/P. Saracco, D. Bosco, F. Veratti, C. Marzachi,

Physiological and Molecular Plant Pathology, Volume 67, Issues 3-5, September 2005-October 2006, Pages 212-219, ISSN 0885-5765, DOI: 10.1016/j.pmpp.2006.02.001.

(<http://www.sciencedirect.com/science/article/pii/S0885576506000099>)

Abstract:

The rate of increase of chrysanthemum yellows phytoplasma (CYP, 16Sr-I) in leaves and roots of the host plant *Chrysanthemum carinatum* following localised and free insect inoculation is described. The fate of CYP in each test plant has been monitored over time using a relative quantification method based on real time PCR. Significant differences in CYP titre have been found both in apical leaves and roots sampled at different times post inoculation. CYP was much more concentrated in young apical leaves and roots compared to old basal leaves. Few thousands and few hundred thousands CYP genome units per nanogram of plant DNA were the maximum amounts found in leaves and roots, respectively. Active movement of CYP towards young developing leaves and roots has been demonstrated.

Keywords: *Chrysanthemum yellows* phytoplasma; *Chrysanthemum carinatum*; *Macrosteles quadripunctulatus*; Quantitative real-time PCR; Multiplication; Movement

Comparative analysis of laboratory freezing methods to establish cold tolerance of detached rhizomes and intact crowns in garden chrysanthemums (*Dendranthema x grandiflora* Tzvelv.)/Dong-Chan Kim, Neil O. Anderson

Scientia Horticulturae, Volume 109, Issue 4, 15 August 2006, Pages 345-352, ISSN 0304-4238, DOI: 10.1016/j.scienta.2006.05.014.

(<http://www.sciencedirect.com/science/article/pii/S030442380600197X>)

Abstract:

Since 1926, the University of Minnesota herbaceous perennial breeding program has released N = 84 garden chrysanthemum cultivars (*Dendranthema x grandiflora*) with important traits for northern temperate climates, such as winter hardiness. Recent breeding objectives have identified the need for development of non-destructive phenotypic markers and destructive laboratory freezing tests for co-selection of cold tolerance in *Dendranthema*, *Gaura*, and other herbaceous perennial flower crops. Such methods have become critical to flower breeding programs in northern temperate regions during periods of above-average winter temperatures and minimal snow cover due to the 'el Nino' effect. Two different, destructive laboratory freezing tests were evaluated for their effectiveness in determining cold tolerance. Acclimated crowns of n = 6 garden chrysanthemum genotypes, ranging from hardy to non-hardy in USDA Z3-4, were used in Omega Block (using detached, emergent rhizomes) and chamber (using entire, intact crowns with emergent, non-emergent rhizomes) freezing test methods. Comparative winter survival in the field was monitored over locations and years. Cold tolerance was assessed at 0 to -12 [degree sign]C with varying ramp and soak time periods. LT50 temperatures and number of living emergent rhizomes were also determined. Rhizome quality at 1, 3, and 5 cm depths was rated for regrowth on a 0 (dead) to 5 (undamaged) scale. The chamber freezing method was the most powerful to discern accurate LT50 values. Cold tolerant genotypes included 'Duluth' and Mn. Selection 98-89-7 (LT50 = -12 [degree sign]C). Four genotypes were rated as non-hardy (LT50 = <=-10 [degree sign]C). Cold-tolerant genotypes also had significantly higher regrowth ratings for rhizomes at 1 and 3 cm depths. Future research will implement the chamber freezing method to assay the inheritance of winter hardiness in intact crowns of segregating populations.

Keywords: Crowns; Freezing method; Herbaceous perennials; Rhizomes; Winter hardiness

Effect of corn and beet pulp based concentrates on sheep milk and cheese fatty acid composition when fed Mediterranean fresh forages with particular reference to conjugated linoleic acid cis-9, trans-11/A. Cabiddu, M. Addis, G. Pinna, M. Decandia, M. Sitzia, G. Piredda, A. Pirisi, G. Molle

Animal Feed Science and Technology, Volume 131, Issues 3-4, Special Issue: Modifying Milk Composition, 15 December 2006, Pages 292-311, ISSN 0377-8401, DOI: 10.1016/j.anifeedsci.2006.06.013. (<http://www.sciencedirect.com/science/article/pii/S0377840106002653>)

Abstract:

Sixty-four Sarda dairy sheep fed fresh forage based diets were allocated to eight groups in early lactation (i.e., 44 days in milk, winter period, growing stage of the forages) and at mid-lactation (i.e., 98 days in milk, spring period, reproductive stage of the forages) to evaluate effects of corn grain or beet pulp based supplementation on milk and cheese fatty acid (FA) composition. Four forage species were compared, being: annual ryegrass (RY; *Lolium rigidum* Gaudin), sulla (SU; *Hedysarum coronarium* L.), burr medic (BM; *Medicago polymorpha* L.) and crown daisy, (CD; *Chrysanthemum coronarium* L.). The supplements differed in carbohydrate composition consisting either of 600 g/kg (dry matter basis) corn grain (concentrate C) or 400 g/kg sugar beet pulp (concentrate BP) and were offered at a fixed rate (C, 500 g/day; BP, 530 g/day) to provide a similar metabolizable energy and crude protein supply. Forage species affected (P<0.05) all variables studied. In both experimental periods, CD and BM forage

groups had higher levels ($P < 0.05$) of conjugated linoleic acid and a lower atherogenicity index (an index of human health benefits) in milk and cheese relative to other groups. Oleic and linoleic acid were also influenced by forage species, with higher level in milks and cheeses of sheep fed crown daisy relative to the other groups. Concentrate source did not influence standard milk yield in winter (1347 ml/day) but BP fed ewes yielded more milk than C fed ewes in spring (1209 and 1099 ml/day, respectively; $P < 0.01$). In winter, while the forages were at vegetative stage, concentrate supplementation did not affect milk fat content (52.0 g/kg versus 52.7 g/kg, respectively) but BP fed ewes had lower milk protein content than C ewes (47.6 g/kg versus 49.1 g/kg, respectively; $P < 0.01$). In contrast, in spring forage at a reproductive stage, BP supplemented ewes had higher milk fat (59.1 g/kg versus 55.5 g/kg; $P < 0.01$) and tended to have higher milk protein (47.4 g/kg versus 46.5 g/kg; $P = 0.08$) contents than C ewes, respectively. Proportion of VA (31.1 g/kg versus 27.5 g/kg; $P < 0.01$) in cheese FA were higher in BP versus C supplemented ewes, whereas C ewes outperformed BP for cheese C18:2 (linoleic acid) (25.6 g/kg versus 28.4 g/kg; $P < 0.01$) and C18:3 (linolenic acid) (16.4 g/kg versus 18.3 g/kg; $P < 0.01$) in winter. In spring, PUFA cheese levels were higher in C versus BP groups when ewes were fed CD forage (60.6 g/kg versus 68.8 g/kg; $P < 0.05$). Only small differences occurred between the FA profile of ripened cheeses and milks within dietary treatment. This study provides evidence that forage species, and to a lesser extent the source of carbohydrate in the concentrate, influence milk and cheese FA profiles.

Keywords: Sheep milk; Ovine cheese; Fatty acid; Conjugated linoleic acid; Forage; Concentrate

Krisan Unggul ScienceDirect 2007

A two-step screening method, using estrogen receptor-mediated transactivation, to measure estrogenicity in edible plants/Yukitomo Arao, Namiko Kanamori, Eri Kikkawa, Hiroko Otsuka, Yasushi Arimoto, Kazuhiro Ikeda, Takahiro Inakuma, Fujio Kayama
Food Chemistry, Volume 104, Issue 3, 2007, Pages 1288-1294, ISSN 0308-8146, DOI: 10.1016/j.foodchem.2007.01.076.

(<http://www.sciencedirect.com/science/article/pii/S0308814607002609>)

Abstract:

Estrogenic activity in 88 edible plants was screened using a human ovarian carcinoma cell line stably transformed with estrogen-responsive elements (ERE) fused to a luciferase (luc) reporter gene (BG1Luc4E(2)). We found 18 plants (ashitaba, avocados, chinese mustard, chinese chive (yellow), chrysanthemum, dokudami, shantung greens, green soybeans, soybean seeds, soybean sprouts, hop, japanese pepper, kidney beans, kuromame, perilla, peas (immature), plantain, and pomegranate juice) expressing estrogenic activity in BG1Luc4E(2) cells. To confirm that the phytoestrogenic activity occurred via estrogen receptors (ER), the reporter vector (ERE-tk-luc) and an expression vector, containing either ER[alpha] or ER[beta], were used to transiently transfect 293T cells. Extracts from avocados, plantain and dokudami did not activate ER[alpha]- and ER[beta]-mediated transcription. In conclusion, we report a simple and quick screening method for phytoestrogenic activity in plant extracts using BG1Luc4E(2) cells and confirmation of the results by ER[alpha]- or ER[beta]-transfected 293T cells. This two-step

screening method has a practical application in screening estrogenic substances in edible plants.

Keywords: Phytoestrogen; Estrogen receptor; Transcription; Screening

Eradication of an invasive alien pest, Thrips palmi/R.J.C. Cannon, L. Matthews, D.W. Collins, E. Agallou, P.W. Bartlett, K.F.A. Walters, A. Macleod, D.D. Slawson, A. Gaunt

Crop Protection, Volume 26, Issue 8, August 2007, Pages 1303-1314, ISSN 0261-2194, DOI: 10.1016/j.cropro.2006.11.005.

(<http://www.sciencedirect.com/science/article/pii/S0261219406003541>)

Abstract:

Thrips palmi Karny, the melon thrips, is a polyphagous pest that has spread widely in tropical and subtropical regions. It is absent from Europe, although outbreaks have occurred in the Netherlands (1988-98), the UK (2000-01) and most recently Portugal (2004). An outbreak of T. palmi occurred in Sussex in 2000. It was already well established when the UK Plant Health Service first notified. High populations were discovered in two glasshouse sites on the same nursery, growing all-year-round chrysanthemums. An intensive, largely chemically based eradication programme was carried out, with applications of aerosol 'space' treatments, systemic and foliar insecticides. Other measures included the use of sticky yellow sheets, methyl bromide fumigation of flowerbeds and plastic mulches. Together, these controls resulted in the collapse of the outbreak, within 7 months. Eradication was subsequently declared after freedom from the pest had occurred over two complete cropping cycles.

Keywords: Thrips palmi; Eradication; Insecticides; Control measures

Krisan Unggul ScienceDirect 2008

Study on differentially expressed gene screening of Chrysanthemum plants under sound stress/Shao Hongbo, Li Biao, Wang Bochu, Tang Kun, Liang Yilong

Comptes Rendus Biologies, Volume 331, Issue 5, May 2008, Pages 329-333, ISSN 1631-0691, DOI: 10.1016/j.crvi.2008.02.007.

(<http://www.sciencedirect.com/science/article/pii/S1631069108000565>)

Abstract:

Environmental stress can induce differential expression of genes of flower plants. It had been found that sound stimulation had an obvious effect on the growth and development of flower plants, but it is not reported on the differentially expressed genes and their expressing characteristics under sound stimulation. This is one of the few reports in terms of using the DDRT-PCR technique for screening the differentially expressed cDNA fragments responding to sound-wave stress on Chrysanthemum. Six differentially expressed cDNA fragments were obtained. Molecular weight of fragments was from 200 to 600 bp, respectively. Among differential fragments acquired, three of them (SA3, SG7-1, and CA2) were found to be positive fragments by northern dot hybridization, whose molecular weight are 270, 580 and 370 bp, respectively. SA3 was differentially expressed and SG7-1 was preferably expressed, while CA2 was restrained by the sound wave. These results indicated that expression of some genes was turned on, meanwhile the stress restrained some genes from expression under the mode of sound-

stress stimulation. To cite this article: S. Hongbo et al., C. R. Biologies 331 (2008).

Keywords: DDRT-PCR (Differentially Display Reverse Transcription-Polymerase Chain Reaction); Northern dot hybridization; Sound stress; Physiological response; Chrysanthemum

Activity of some insecticides in preventing transmission of chrysanthemum yellows phytoplasma ('Candidatus Phytoplasma asteris') by the leafhopper *Macrosteles quadripunctulatus* Kirschbaum/P. Saracco, C. Marzachi, D. Bosco

Crop Protection, Volume 27, Issue 1, January 2008, Pages 130-136, ISSN 0261-2194, DOI: 10.1016/j.cropro.2007.05.002.

(<http://www.sciencedirect.com/science/article/pii/S0261219407001329>)

Abstract:

Four insecticides, the organophosphates (OPs) fenitrothion, chlorpyrifos ethyl and malathion, and the neonicotinoid imidacloprid, were tested for their capacity to limit the transmission of chrysanthemum yellows phytoplasma (CYP) by the leafhopper vector *Macrosteles quadripunctulatus* to potted daisy plants, *Chrysanthemum carinatum*. The OPs were applied to the foliage as sprays, while imidacloprid was applied to the soil as a drench. Transmission trials were first done with groups of 5 infective leafhoppers caged on single plants at 1, 4, 7, 10, 15 and 20 days after insecticide treatments. In a second experiment, 20 infective leafhoppers were released in a cage containing 32 treated daisies and were free to move among the plants as long as they lived. The influence of source plant treatments on phytoplasma acquisition by the vector was also investigated by caging leafhopper nymphs on treated plants; 3 weeks later, surviving leafhoppers were tested for the presence of CYP by polymerase chain reaction and by transmission assays. The first and second experiments, with acquisition access periods on untreated source plants, were designed to mimic primary infections due to leafhoppers coming from outside the field. The third experiment was designed to model secondary, within-crop spread of phytoplasmas, since the source plants were treated, in an attempt to prevent phytoplasma acquisition. The OP-treated plants were significantly less infected than water-treated plants only at 1 and 4 days after treatment application, while those treated with imidacloprid were significantly protected at all times tested. The second experiment confirmed that imidacloprid was much more effective than OPs in preventing the CYP transmission. When caged on source plants treated 40 days earlier, most leafhoppers died but the survivors were able to acquire and transmit the phytoplasma. We conclude that, when the primary purpose is to protect the plants from the incoming infectious insects, use of the neonicotinoid is advisable. When the primary purpose is to suppress the vector population, OPs are likely to be effective.

Keywords: Fenitrothion; Chlorpyrifos ethyl; Malathion; Imidacloprid; Candidatus *Phytoplasma asteris*; *Macrosteles quadripunctulatus*

Extraction of cadmium and tolerance of three annual cut flowers on Cd-contaminated soils/Khajanchi Lal, P.S. Minhas, Shipra, R.K. Chaturvedi, R.K. Yadav

Bioresource Technology, Volume 99, Issue 5, March 2008, Pages 1006-1011, ISSN 0960-8524, DOI: 10.1016/j.biortech.2007.03.005.

(<http://www.sciencedirect.com/science/article/pii/S0960852407002210>)

Abstract:

To evaluate the production potential and Cd removal by three flower crops, viz.: marigold (*Tagetes erecta*), chrysanthemum (*Chrysanthemum indicum*) and gladiolus (*Gladiolus grandiflorus*), an experiment was conducted on differentially contaminated soils (DTPA-Cd 0.6-68.4 mg kg⁻¹). Biototoxicity of Cd lead to reductions in growth and flower yield of marigold at DTPA-Cd [greater-or-equal, slanted] 7.9 mg kg⁻¹ soil, while the productivity of chrysanthemum and gladiolus was sustained up to 21.2 mg kg⁻¹. DTPA-Cd for 50% yield reduction (C50) was 85, 106 and 215 mg kg⁻¹ soil for marigold, chrysanthemum and gladiolus, respectively, that indicates a better Cd-tolerance in gladiolus. The uptake of Cd increased with contents in soils and the maximum accumulation occurred in leaves. Among the economic parts, gladiolus spikes accumulated the highest Cd (7.2) followed by flowers of marigold (6.5) and chrysanthemum (4.0 mg kg⁻¹). But, because of higher biomass, the total Cd removal was the maximum with chrysanthemum (8.3) followed by gladiolus (6.0) and the minimum (2.6 mg m⁻²) with marigold. Gladiolus with highest tolerance and Cd-content in saleable part holds potential to clean up the moderately contaminated soils.

Keywords: Cadmium toxicity; Phyto-remediation; Marigold; Chrysanthemum; Gladiolus

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ScienceDirect 2009

Gibberellin promotes flowering of chrysanthemum by upregulating CmFL, a chrysanthemum Floricaula/Leafy homologous gene/Katsuhiko Sumitomo, Tuoping Li, Tamotsu Hisamatsu

Plant Science, Volume 176, Issue 5, May 2009, Pages 643-649, ISSN 0168-9452, DOI: 10.1016/j.plantsci.2009.02.003.

(<http://www.sciencedirect.com/science/article/pii/S0168945209000351>)

Abstract:

The plant hormone gibberellin (GA) induces flower formation in several long-day (LD) plants, and exogenous GA can partly substitute for chilling treatment in cold-dependent plants. Both chilling and GA are required to promote flowering of a short-day (SD) plant chrysanthemum as observed in many plants. Chilling and GA requirement for flowering of four cultivars were examined, and genetic variation in them was shown: those that required GA also required chilling for flowering, but those that did not require GA showed no chilling requirement. With regard to LEAFY in *Arabidopsis thaliana*, GA promoted the expression of CmFL, a FLORICAULA/LEAFY homologous gene from chrysanthemum, and the upregulation of CmFL required GA in cultivars with a chilling requirement. Therefore, this GA requirement can be principally attributed to the chilling requirement for flowering.

Keywords: Chilling requirement; Chrysanthemum; FLORICAULA/LEAFY homologous gene; Flowering; Gibberellin

Recruitment and attrition of associated plants under a shading crop canopy: Model selection and calibration/Eveline S.C. Stilma, Karel J. Keesman, Wopke van der Werf

Ecological Modelling, Volume 220, Issue 8, 24 April 2009, Pages 1113-1125, ISSN 0304-3800, DOI: 10.1016/j.ecolmodel.2009.01.015.

(<http://www.sciencedirect.com/science/article/pii/S0304380009000313>)

Abstract:

Associated plant and animal diversity provides ecosystem services within crop production systems. The importance of the maintenance or

restoration of diversity is therefore increasingly acknowledged. Here we study the population dynamics of associated annual plants ('weeds') during the growth of a crop in a season and introduce a minimal model to characterize the recruitment and attrition of the associated plants under the influence of shading by the crop. A mechanistically based, logistic, light interception model was parameterized with light interception measurements in two single crops (barley and rye) and in mixtures of these cereals with peas. Population dynamics data were collected for the annuals *Papaver rhoeas*, *Centaurea cyanus*, *Chrysanthemum segetum*, and *Misopates orontium*. A minimal population dynamics model was identified for each annual plant species, using system identification techniques as model selection and calibration. For three of the four species, a two-parameter model consisting of light-dependent recruitment in combination with a constant death rate, explained 75-96% of the variation in plant densities over the season. Model fit for *P. rhoeas* improved when a germination delay of 200 [degree sign]Cd after sowing was included, resulting in a three-parameter model. The developed models have a simple yet biologically meaningful structure and the values of the parameters give a useful summary of the population dynamics of an annual plant population under the influence of the dynamic leaf cover of a shading crop. Further development of these models can contribute to systems design for maintaining plant diversity in crop systems.

Keywords: System identification; Model calibration; Minimal model; Population dynamics; Crop weeds; Plant recruitment; Attrition

Reproductive characteristics of *Opisthopappus taihangensis* (Ling) Shih, an endangered Asteraceae species endemic to China/Jian Li, Teng Nianjun, Chen Fadi, Chen Sumei, Sun Chunqing, Fang Weimin **Scientia Horticulturae**, Volume 121, Issue 4, 4 August 2009, Pages 474-479, ISSN 0304-4238, DOI: 10.1016/j.scienta.2009.02.025.

(<http://www.sciencedirect.com/science/article/pii/S0304423809001265>)

Abstract:

Opisthopappus taihangensis is an endangered species endemic to China and represents an important genetic resource for chrysanthemum improvement. We describe here its basic reproductive characteristics. The anthers are tetrasporangiate and the anther wall is composed of an epidermis, endothecium, middle layer and tapetum. The middle layer is lost by the microspore tetrad stage, and the tapetum disintegrates at the trinucleate pollen stage. Meiosis in the microspore mother cells is of the simultaneous type, and the tetrad is tetrahedral in shape. Mature pollen grains have three germinal apertures, two sperm nuclei and one vegetative nucleus. The in vitro pollen germination rate is only ~10%. The ovule is anatropous, dual-integument, tenuinucellatae and the development of the embryo sac follows the *Oenothera* pattern. The archesporial cell below the nucellus epidermis functions as the megaspore mother cell and forms a linear tetrad. The embryo passes through a globular, heart and torpedo stage before maturing into a cotyledon embryo. The endangerment of *O. taihangensis* may be associated with low reproductive capacity, as a consequence of poor pollen viability.

Keywords: Embryogenesis; Gametogenesis; Megasporogenesis; Microsporogenesis

Intergeneric hybridizations between *Opisthopappus taihangensis* and *Chrysanthemum lavandulifolium*/Deyan Yang, Xiao Hu, Zhaohui Liu, Huien Zhao

Scientia Horticulturae, Volume 125, Issue 4, 26 July 2010, Pages 718-723, ISSN 0304-4238, DOI: 10.1016/j.scienta.2010.05.002.

(<http://www.sciencedirect.com/science/article/pii/S0304423810002141>)

Abstract:

For the first time, reciprocal intergeneric hybridizations were produced between *Opisthopappus taihangensis* and *Chrysanthemum lavandulifolium* without emasculation. About 20% seed set was similarly obtained from reciprocal hybridization. Only 5 and 6 of the viable plants observed from 45 and 78 seedling survived present some conspicuous intermediate characteristics. Phenotypic evaluation among the progenies of the parents and the putative hybrids was performed carefully since an average of 5.3% seed set was produced in the type of self-pollination using pollen from the same flower and >10% seed set was similarly obtained in the types of self-pollination using pollen from different flowers in a plant and flowers in individual plants from different seeds. One individual of each hybrid shared the inflorescence habit with the pollen plant was confirmed further by the sequence of ncpGS. The two hybrids might be used as bridges of breeding of multi-generic hybrids.

Keywords: Intergeneric hybrids; Reciprocal crosses; NcpGS; *Opisthopappus*; *Chrysanthemum*

Flower morphologic anatomy and embryological characteristics in *Chrysanthemum multicaule* (Asteraceae)/Yanming Deng, Sumei Chen, Nianjun Teng, Fadi Chen, Fengtong Li, Aiping Song, Zhiyong Guan

Scientia Horticulturae, Volume 124, Issue 4, 1 May 2010, Pages 500-505, ISSN 0304-4238, DOI: 10.1016/j.scienta.2010.02.009.

(<http://www.sciencedirect.com/science/article/pii/S030442381000066X>)

Abstract:

Chrysanthemum multicaule is an annual herbaceous ornamental species. The inflorescence is gynomonocious and consists of bisexual tubular florets and female ray florets. The pistils consist of two stigmas which are of the open type with a hollow stylar canal. At the base of the tubular floret style, the pistil is surrounded by oil gland cells. The anthers are tetrasporangiate and the young anther wall is composed of epidermis, endothecium, middle layer and tapetum. The mature anther wall comprises only thickened endothecium after the release of the pollens. In the tubular florets, simultaneous microsporocyte meiotic cytokinesis results in mostly tetrahedral with a small proportion of decussate tetrads. The mature pollen grain is tricellular. The ovules are unitegmic and tenuinucellate, and the nucellus degenerates during the development of the megasporocyte. The development of the embryo sac follows the Polygonum type. At 4-6 days after blooming, the embryos reached the globular stage, thereafter passing through the heart- and torpedo-shape stages before maturing into the cotyledon embryos. From blooming to seed maturity, it takes about 3-4 weeks under our conditions.

Keywords: *Chrysanthemum multicaule*; Gametogenesis; Sporogenesis; Embryogenesis; Anatomy

Anther wall development, microsporogenesis and microgametogenesis in male fertile and sterile chrysanthemum (*Chrysanthemum morifolium* Ramat., Asteraceae)/Fengtong Li, Sumei Chen, Fadi Chen, Nianjun Teng, Weimin Fang, Fei Zhang, Yanming Deng

Scientia Horticulturae, Volume 126, Issue 2, 13 September 2010, Pages 261-267, ISSN 0304-4238, DOI: 10.1016/j.scienta.2010.06.013.
(<http://www.sciencedirect.com/science/article/pii/S0304423810002712>)

Abstract:

Anther wall development, microsporogenesis and microgametogenesis were compared between a normal male fertile chrysanthemum cultivar 'NJAU04-29-2' and the two male sterile selections 'rm20-11' (anther indehiscent) and 'NJAU05-52-2' (anther aborted). In both of the two male sterile types, the tapetum enlarged abnormally and showed signs of disorganization of walls at the onset of meiosis, the pollen was aborted, the anthers appeared shrunken, and the anther vascular bundle and connective tissue were degenerated by anthesis. In 'rm20-11', the two smaller pollen sacs began to degenerate at the microsporogenesis stage, so that only one or two microsporangia developed, while in 'NJAU05-52-2', only one or two microsporangia were formed following the archesporial cell stage, and most of the microspore mother cells degenerated during the course of meiosis.

Keywords: Anther wall development; Chrysanthemum; Male sterile; Microgametogenesis; Microsporogenesis

Feeding perturbation and toxic activity of five *Chrysanthemum* species crude extracts against *Spodoptera littoralis* (Boisduval) (Lepidoptera; Noctuidae)/Dalila Haouas, Guido Flamini, Monia Ben Halima-Kamel, Mohamed Habib Ben Hamouda

Crop Protection, Volume 29, Issue 9, September 2010, Pages 992-997, ISSN 0261-2194, DOI: 10.1016/j.cropro.2010.05.002.
(<http://www.sciencedirect.com/science/article/pii/S0261219410001195>)

Abstract:

The effect of the whole methanol extracts of five *Chrysanthemum* species on feeding and performance of *Spodoptera littoralis* (Boisduval) larvae has been investigated in vitro. The extracts exhibited an anti-feeding and phagostimulating activities against cotton leafworm larvae when applied either on leaf discs or incorporated into an artificial diet. Under chosen conditions, the antifeedant index calculated over 24 h for sixth instar larvae significantly varied from 78.55 for *Chrysanthemum segetum* L. to -44.18 for *Chrysanthemum fuscatum* Desf. at the dose of 1000 ppm. Toxicity of the extracts was manifested by a high mortality, reduced growth rates, and low weight gain by larvae fed on diets containing 1000-10,000 ppm of the extract. Any one of the larvae treated with *Chrysanthemum macrotum* (D.R.) Ball. leaves crude extract survived to pupation at the two higher concentrations. The time to pupation increased for *Chrysanthemum grandiflorum* flowers crude extract from 11.40 +/- 0.93 to 28.93 +/- 10.92 days as the extract concentration in the diet increased from 0 to 10,000 ppm. The ingestion of crude extract by the third instar larvae reduced significantly the consumption, growth and utilisation of the ingested and digested food, and reduced digestibility.

The crude extract of the leaves of *C. macrotum*, dissolved in acetone and topically applied on sixth instar larvae, showed a quite high mortality (95%).

These results suggest the presence in the extracts of anti-feeding and/or toxic substances, active by consumption and topical application.

The identification of these compounds and their action mode will be object of further studies.

Keywords: Larval development; Chrysanthemum sp. crude extracts; Antifeeding; Toxicity; Phagostimulating; Topical application

Preliminary genetic linkage map of chrysanthemum (*Chrysanthemum morifolium*) cultivars using RAPD, ISSR and AFLP markers/Fei Zhang, Sumei Chen, Fadi Chen, Weimin Fang, Fengtong Li
Scientia Horticulturae, Volume 125, Issue 3, 28 June 2010, Pages 422-428, ISSN 0304-4238, DOI: 10.1016/j.scienta.2010.03.028.
(<http://www.sciencedirect.com/science/article/pii/S0304423810001457>)

Abstract:

A genetic linkage map of chrysanthemum (*Chrysanthemum morifolium*) was constructed by genotyping 142 F1 progeny of the bi-parental cross 'Yuhualuoying' x 'Aoyunhanxiao' with a combination of RAPD, ISSR and AFLP markers in a double pseudo-testcross mapping strategy. A total of 567 polymorphic markers, including 153 RAPDs, 61 ISSRs and 353 AFLPs, were used in linkage mapping. 336 of 567 (60%) markers were grouped on the two parental maps, leaving 231 (40%) markers unlinked. In the 'Yuhualuoying' linkage map, 210 markers including 116 testcross and 94 intercross markers were placed in 12 major and 32 minor (8 triplets and 24 doublets) linkage groups, covering 1034 cM with an average map distance of 6.2 cM between adjacent markers. In 'Aoyunhanxiao' linkage map, 190 markers consisting of 113 testcross and 77 intercross markers were resolved into 9 major and 24 minor linkage groups, with genome coverage of 1095 cM and a mean inter-marker separation of 6.9 cM between adjacent markers. Six pairs of homologous linkage groups were established on the basis of 64 intercross markers shared by the two parental maps. The maps lay a foundation for further quantitative traits loci (QTL) mapping and marker-assisted breeding of chrysanthemum.

Keywords: AFLP; Chrysanthemum; Genetic mapping; ISSR; RAPD

Comparative analysis of genetic diversity in medicinal *Chrysanthemum morifolium* based on morphology, ISSR and SRAP markers/Qing-Song Shao, Qiao-Sheng Guo, Yan-Ming Deng, Hai-Peng Guo
Biochemical Systematics and Ecology, Volume 38, Issue 6, December 2010, Pages 1160-1169, ISSN 0305-1978, DOI: 10.1016/j.bse.2010.11.002.
(<http://www.sciencedirect.com/science/article/pii/S0305197810002103>)

Abstract:

The diversity and genetic relationship among 29 populations of *Chrysanthemum morifolium*, one of *Chrysanthemum indicum* and one of *Chrysanthemum nankingense* from China were analyzed using morphological traits and molecular markers. Twenty morphological traits were scored as well as 182 ISSR marker-fragments, as amplified by 22 primers [the percentage of polymorphic bands (PPB): 81.87%], and 243 SRAP marker-fragments as generated by 26 primer pairs (PPB: 75.72%). Mantel's test indicated significant correlation ($r = 0.624$) of morphological trait and SRAP. By contrast, the morphological trait showed low correlation with ISSR ($r = 0.246$). Cluster analysis showed groupings of the accessions according to all four methods correlated well with their geographic region of origin, and most populations from the south of China were classified into one cluster and most populations from the north of China were classified into another cluster. Finally, an appropriate strategy for conserving the *C. morifolium* germplasm was proposed.

Keywords: Chrysanthemum morifolium; Genetic diversity; Morphological traits; ISSR; SRAP

Effects of Acetylsalicylic Acid and Calcium Chloride on Photosynthetic Apparatus and Reactive Oxygen-Scavenging Enzymes in Chrysanthemum Under Low Temperature Stress with Low Light, Zhen Feng, Fang liang, Cheng-shu Zheng, Huai-rui Shu, Xian-zhi Sun, Yong-kweon Yoo,

Agricultural Sciences in China, Volume 9, Issue 12, December 2010, Pages 1777-1786, ISSN 1671-2927, DOI: 10.1016/S1671-2927(09)60276-5. (<http://www.sciencedirect.com/science/article/pii/S1671292709602765>)

Abstract:

The effects of acetylsalicylic acid (ASA), CaCl₂, and ASA + CaCl₂ on the photosynthetic apparatus and antioxidant enzyme activities were investigated in chrysanthemum Jinba (a cut flower cultivar) under low temperature stress with low light (TL stress) (16/12[degree sign]C, day/night, PFD 100 [mu]mol m⁻² s⁻¹). The results showed that under TL stress, the net photosynthesis rate (Pn), carboxylation efficiency (CE), apparent quantum yield (AQY), maximal photochemical efficiency (Fv/Fm) of PSII, quantum yield of PSII electron transport (oPSII), and photochemical quenching (qP) of the chrysanthemum leaves in all treatments were significantly decreased, but the decreases were alleviated by ASA, CaCl₂, and ASA + CaCl₂ treatments compared with the controls. The alleviating effect of ASA + CaCl₂ was better than either ASA or CaCl₂ single treatment. Moreover, the ASA + CaCl₂ treatment highly improved the chlorophyll content, relatively improved the number and size of chloroplast and starch grain in the leaves of chrysanthemum plants compared with ASA and CaCl₂ treatments. It was indicated that ASA and/or CaCl₂ could regulate the photosynthetic functions in the leaves of chrysanthemum plants to enhance the resistance against TL stress. On the other hand, reduction in relative conductance rate implied that ASA and/ or CaCl₂ could protect from membrane injury in leaves of chrysanthemum plants. The activities of SOD, POD, and CAT in the treated leaves of chrysanthemum were increased as compared with the controls. It was suggested that ASA and/or CaCl₂ had positive regulation effects on the defence enzyme activities in chrysanthemum leaves which could protect the photosynthetic apparatus to a certain degree under the TL stress. In brief, the treatment of ASA together with CaCl₂ was better for chrysanthemum plants to adapt TL stress than single ASA or CaCl₂ treatments.

Keywords: Acetylsalicylic acid; Ca²⁺; chrysanthemum; Low temperature; Low light; Photosynthetic apparatus; Antioxidant enzyme

Activity of benzothiadiazole on chrysanthemum yellows phytoplasma ('Candidatus Phytoplasma asteris') infection in daisy plants/R.

D'Amelio, C. Marzachi, D. Bosco

Crop Protection, Volume 29, Issue 10, October 2010, Pages 1094-1099, ISSN 0261-2194, DOI: 10.1016/j.cropro.2010.03.011.

(<http://www.sciencedirect.com/science/article/pii/S0261219410000669>)

Abstract:

A commercial preparation of the plant resistance elicitor benzothiadiazole (BTH) (Bion, Syngenta Crop Protection) was tested for its capacity to induce systemic resistance against chrysanthemum yellow phytoplasma (CYP) infection in the Chrysanthemum carinatum plant. Following one 2.4 mM BTH application, plants were exposed to CYP-infective Macrosteles quadripunctulatus leafhoppers. Symptom development and phytoplasma multiplication in the test plants were measured over time. BTH application delayed symptom development and

phytoplasma multiplication in treated plants compared with the control ones. CYP titre and symptom severity were significantly lower for the first two weeks post-inoculation in treated plants compared with the control ones, suggesting that systemic acquired resistance (SAR) induced by BTH in *C. carinatum* is temporary. Higher concentrations of BTH resulted in phytotoxic effects involving the whitening of apical leaves. BTH application was ineffective in reducing the transmission efficiency of CYP by its leafhopper vector. Actually, in both single and group transmission tests, the proportion of infected plants was similar among BTH-treated and untreated plants. The survival of *M. quadripunctulatus* was unaffected by feeding on BTH-treated daisy plants. Moreover, when leafhoppers were allowed to choose between treated and untreated plants, they showed no preference. We conclude that SAR induced in daisy plants by BTH has no detrimental effects on the vector leafhopper. If the activity of BTH against phytoplasmas is confirmed also on other phytoplasma/host-plant associations, BTH applications might be included in new, more environmentally friendly, integrated management strategies of phytoplasmoses.

Keywords: Benzothiadiazole; Resistance elicitor; Systemic acquired resistance; Chrysanthemum yellows phytoplasma; *Macrostele quadripunctulatus*

Isolation, identification and activity of natural antioxidants from costmary (*Chrysanthemum balsamita*) cultivated in Lithuania/Audrius Pukalskas, Petras Rimantas Venskutonis, Ingrid Dijkgraaf, Teris A. van Beek

Food Chemistry, Volume 122, Issue 3, 1 October 2010, Pages 804-811, ISSN 0308-8146, DOI: 10.1016/j.foodchem.2010.03.064.
(<http://www.sciencedirect.com/science/article/pii/S0308814610003419>)

Abstract:

The sweet, minty-lemony leaves of costmary (*Chrysanthemum balsamita*) are used for salads and tea, and as flavourings in meats, sausages, cakes and ale. In this study, the extracts isolated from costmary aerial parts were investigated as antioxidants in rapeseed oil and as free radical-scavengers in DPPH and ABTS+ assays. It was found that costmary extracts and their fractions were weak antioxidants in rapeseed oil; however, some fractions were active in scavenging synthetic free radicals. Crude methanol-water extract, its tert-butyl methyl ether and butanol fractions were the most effective in DPPH assay by scavenging 87.0%, 86.9% and 86.4% of radicals present in the reaction, respectively. Several active compounds were detected in these fractions, using HPLC with on-line radical-scavenging detection. After multi-step fractionation of these fractions, four radical-scavenging constituents were isolated and their properties were assessed by DPPH (antiradical power, ARP, calculated as an inverse value of the effective concentration, 1/EC50) and ABTS+ (Trolox equivalent antioxidant capacity, TEAC6min) free radical-scavenging assays. The following structures were elucidated by NMR and MS: 5-O-caffeoylquinic acid (ARP = 3.85; TEAC6min = 0.60), 3,5-O-dicaffeoylquinic acid (ARP = 6.25; TEAC6min = 1.16), 5,7,4'-trihydroxy-3',8-dimethoxyflavone (ARP = 0.03) and 5,7,3',4'-tetrahydroxy-3,8-dimethoxyflavonol (ARP = 3.79; TEAC6min = 1.50).

Keywords: Costmary; *Chrysanthemum balsamita*; Antioxidants; Radical-scavenging

Phylogeography of *Chrysanthemum indicum* L. (Compositae) in China based on trnL-F sequences/Hai-ling Fang, Qiao-sheng Guo, Hai-jin Shen, Qing-song Shao

Biochemical Systematics and Ecology, Volume 38, Issue 6, December 2010, Pages 1204-1211, ISSN 0305-1978, DOI: 10.1016/j.bse.2010.12.011.

(<http://www.sciencedirect.com/science/article/pii/S0305197810002231>)

Abstract:

Using chloroplast DNA (cpDNA) trnL-F sequences, we studied the phylogeographic pattern and demographic history of *Chrysanthemum indicum* with 81 individuals from 27 populations representing the partial geographic range in China. Fifteen haplotypes were identified based on nucleotide variation. Relatively high levels of haplotype diversity ($H_d = 0.783$) and low levels of nucleotide diversity ($\pi = 0.00521$) were detected in *C. indicum*. An analysis of molecular variance (AMOVA) indicated that most of the genetic variation (59.9%, $P < 0.001$) was partitioned within populations. Genetic differentiation among populations was high ($F_{ST} = 0.35$), suggesting that there is little gene flow among populations. Nested clade analysis showed that 15 haplotypes formed twelve 1-step clades, five 2-step clades and two 3-step clades, with four clades showing significant geographical association. We concluded that contiguous range expansion and restricted gene flow/dispersal but with some long distance dispersal seemed to have shaped the present-day distribution of the haplotypes of *C. indicum* in China.

Keywords: *Chrysanthemum indicum* L.; Phylogeography; Chloroplast DNA; trnL-F sequences

Chrysanthemum coronarium as a modulator of fatty acid biohydrogenation in the rumen/T.A. Wood, E. Ramos-Morales, N. McKain, X. Shen, C. Atasoglu, R.J. Wallace

Animal Feed Science and Technology, Volume 161, Issues 1-2, 13 October 2010, Pages 28-37, ISSN 0377-8401, DOI:

10.1016/j.anifeedsci.2010.07.016.

(<http://www.sciencedirect.com/science/article/pii/S0377840110002385>)

Abstract:

Inclusion of a daisy plant, *Chrysanthemum coronarium*, in a dairy sheep diet has been reported to result in increased concentrations of health-promoting rumenic acid (RA; cis-9,trans-11 CLA) and vaccenic acid (VA; trans-11-18:1) in milk. The aims of the present study were to determine if the reported change in milk fatty acid composition was the result of the effects of *C. coronarium* on the biohydrogenation of linoleic acid (LA; cis-9,cis-12-18:2) by ruminal microorganisms, and to investigate which constituents of *C. coronarium* may be responsible for the observed effects. Ruminal digesta from four sheep receiving a mixed hay-concentrate diet were incubated in vitro with LA in the presence or absence of dried whole-plant *C. coronarium* var. Primrose Gem. Rates of LA disappearance and stearic acid (SA; 18:0) production decreased as a result of *C. coronarium* addition, and VA accumulation doubled.

Chrysanthemum parthenium and *Chrysanthemum vulgare* had much smaller effects on biohydrogenation. *C. coronarium* added to cultures of the only known ruminal SA-forming bacterium, *Butyrivibrio proteoclasticus*, also inhibited LA metabolism by, but not growth of, this species. Lipid analysis indicated that *C. coronarium* var. Primrose Gem had a high content of [α]-linolenic acid (LNA; cis-9,cis-12,cis-15-18:3; 8.79 mg/g DM) compared to the other samples (<0.50 mg/g DM). In fractions derived from differential (Soxhlet) solvent extraction, only extracts containing LNA affected LA metabolism by *B. proteoclasticus*. LNA and

coronaric acid ((+)-cis-9,10-epoxy,cis-12-18:1) were investigated as the main components present in *C. coronarium* that could have altered the biohydrogenation of LA in vitro. LNA inhibited biohydrogenation of LA causing a slowdown of RA and VA formation and a subsequent increase of the accumulation of RA and VA over time. Coronaric acid showed an inhibitory effect on the metabolism of LA, although it did not correspond to a higher accumulation of intermediates. It was concluded that the combined effect of LNA and coronaric acid in *C. coronarium* could be responsible for changes in the biohydrogenating activity of ruminal bacteria causing an increase of VA and a decrease in SA in vitro. This effect would lead to an increased flow of VA from the rumen which in turn would lead to an increase in RA and VA in milk from ruminants receiving *C. coronarium*.

Keywords: Biohydrogenation; Conjugated linoleic acid; Rumen; Vaccenic acid

Effect of traditional Korean medicinal (TKM) triherbal extract on the innate immune system and disease resistance in *Paralichthys olivaceus* against *Uronema marinum*/Ramasamy Harikrishnan, Jaehyun Heo, Chellam Balasundaram, Man-Chul Kim, Ju-Sang Kim, Yong-Jae Han, Moon-Soo Heo, **Veterinary Parasitology**, Volume 170, Issues 1-2, 28 May 2010, Pages 1-7, ISSN 0304-4017, DOI: 10.1016/j.vetpar.2010.01.046.

(<http://www.sciencedirect.com/science/article/pii/S0304401710000804>)

Abstract:

We report the effect of aqueous-, ethanol- and methanol-solvent-derived extracts of three traditional Korean herbs, *Punica granatum*, *Chrysanthemum cinerariaefolium* and *Zanthoxylum schinifolium*, by monitoring the innate immune mechanisms, such as phagocytosis activity, respiratory burst activity, alternative complement activity and lysozyme activity and the functional immunity in terms of percentage mortality and relative percent survival (RPS) in olive flounder (*Paralichthys olivaceus*) against *Uronema marinum* (1×10^5 ciliates ml⁻¹) for 30 days. Fish were intraperitoneally administered with 5, 50 and 100 mg kg⁻¹ body weight of each traditional Korean medicinal (TKM) solvent extract except the control and infected untreated groups. In all the treated groups at concentrations of 50 and 100 mg kg⁻¹ body weight, the chosen innate immune parameters were found significantly enhanced when compared to 0 mg kg⁻¹ dose. However, at 5 mg kg⁻¹ the tested immune parameters did not vary. Administration of TKM solvent extracts preceding the challenge with *U. marinum* for 30 days significantly reduced the percentage mortality with the consequent increase in RPS. Administration of 50 and 100 mg kg⁻¹ TKM solvent extracts clearly enhanced the innate immune responses and disease resistance in *P. olivaceus* against *U. marinum*.

Keywords: *Paralichthys olivaceus*; *Uronema marinum*; Innate immunity; Traditional Korean medicinal herb; Disease resistance

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Sciencedirect 2011

CgDREBa transgenic chrysanthemum confers drought and salinity tolerance/Sumei Chen, Xinli Cui, Yu Chen, Chunsun Gu, Hengbin Miao, Haishun Gao, Fadi Chen, Zhaolei Liu, Zhiyong Guan, Weimin Fang

Environmental and Experimental Botany, In Press, Corrected Proof,
Available online 24 June 2011, ISSN 0098-8472, DOI:
10.1016/j.envexpbot.2011.06.007.
(<http://www.sciencedirect.com/science/article/pii/S0098847211001493>)

Abstract:

The drought and salinity tolerances of a creeping ground-cover chrysanthemum variety 'Yuhuaxunzhang' were compared to the performance of its two derived transgenic lines carrying a drought-responsive element binding (DREB) factor from chrysanthemum designated as CgDREBa. The over-expression of CgDREBa conferred a measure of tolerance to both stresses. The transgenic lines showed a higher survival rate and were better able to retain fresh weight in the presence of stress. Activities of superoxide dismutase and peroxidase and the proline content were all higher in the leaves of the transgenic plants after a prolonged period of stress, but they accumulated less malondialdehyde. CgDREBa appears to function as a transcription activator of genes within the oxidative and osmotic homeostasis transduction pathways, and represents a promising candidate for a biotechnological approach to improve the level of abiotic stress tolerance in plants.

Keywords: Drought tolerance; Salinity tolerance; Transgenic chrysanthemum; CgDREBa

Protective effect of *Chrysanthemum indicum* Linne against 1-methyl-4-phenylpyridinium ion and lipopolysaccharide-induced cytotoxicity in cellular model of Parkinson's disease/In-Su Kim, Hyun-Myung Ko, Sushruta Koppula, Byung-Wook Kim, Dong-Kug Choi

Food and Chemical Toxicology, Volume 49, Issue 4, April 2011, Pages 963-973, ISSN 0278-6915, DOI: 10.1016/j.fct.2011.01.002.
(<http://www.sciencedirect.com/science/article/pii/S0278691511000044>)

Abstract:

Chrysanthemum indicum Linn. (CI) has been used in Oriental medicine for several centuries. In the present study, the effect of CI extract was evaluated against 1-methyl-4-phenylpyridinium ion (MPP⁺)-induced damage in SH-SY5Y cells and lipopolysaccharide (LPS)-stimulated BV-2 microglial cells. Cell viability, oxidative damage, reactive oxygen species, expression of Bcl-2/Bax, and poly (ADP-ribose) polymerase (PARP) proteolysis were evaluated using SH-SY5Y cells. Production of iNOS, prostaglandin E₂, and pro-inflammatory cytokines like tumor necrosis factor (TNF)- α , interleukin (IL)-1 β , interleukin (IL)-6, expression of cyclooxygenase type-2 (COX-2) and type-1 (COX-1) were examined in activated BV-2 microglia. At 1, 10 and 100 μ g, CI inhibited cell loss, decreased the reactive oxygen species production, regulated the Bax/Bcl-2 ratio and inhibited PARP proteolysis in MPP⁺-induced SH-SY5Y cells. Furthermore, CI suppressed the production of prostaglandin E₂, expression of cyclooxygenase type-2 (COX-2), blocked I κ B- α degradation and activation of NF- κ B p65 in BV-2 cells in a dose-dependent manner. The molecular mechanisms involved by CI might involve its inhibitory actions both on neuronal apoptosis and neuroinflammatory NF- κ B/I κ B- α signaling pathway. The present investigation scientifically supports the long history and safe usage of CI as an important functional food with potential benefits in ameliorating deleterious conditions seen in PD.

Keywords: Neurodegeneration; SH-SY5Y cells; Microglia; Apoptosis; Reactive oxygen species; *Chrysanthemum indicum*

Modelling the effects of soil water potential on growth and quality of cut chrysanthemum (*Chrysanthemum morifolium*/Lu Lin, Wenwen Li, Jingqing

Shao, Weihong Luo, Jianfeng Dai, Xinyou Yin, Yanbao Zhou, Chunjiang Zhao

Scientia Horticulturae, Volume 130, Issue 1, 26 August 2011, Pages 275-288, ISSN 0304-4238, DOI: 10.1016/j.scienta.2011.06.008.

(<http://www.sciencedirect.com/science/article/pii/S0304423811002974>)

Abstract:

A complete dynamic model was developed to describe the effects of soil water potential (WP) on the growth and external quality of standard cut chrysanthemum (*Chrysanthemum morifolium*) in order to optimise water management of greenhouse crops. Experiments using chrysanthemum cv. 'Jinba' with different planting dates and levels of water treatment were conducted in a lean-to type greenhouse from 2006 to 2008. The dynamics of leaf area index (LAI), dry matter partitioning, and external quality traits (plant height, number of leaves per plant, flower-head diameter and peduncle length) were first determined as functions of accumulated photothermal index (PTI). Impacts of WP on leaf photosynthetic rate, LAI, dry matter partitioning, and the external quality traits were quantified via introducing the experimentally identified effects of WP on the parameters in the light response curve of leaf photosynthetic rate and the PTI-based functions. These quantitative relationships were incorporated into a generic crop growth model SUCROS. Using independent experimental data, the model was found to give good predictions for biomass production, dry weight of organs, and the external quality traits of the chrysanthemum cultivar grown under different levels of water supply. The coefficient of determination (r^2) between the predicted and measured results was 0.91 for LAI, 0.88 for biomass production, and varied between 0.83 and 0.93 for organ dry weight and the external quality traits. Further evaluation is needed when applying this model to a wider range.

Keywords: Chrysanthemum; Biomass production; Dry matter partitioning; External quality; Soil water potential; Model

Carbon mineralization in the soils under different cover crops and residue management in an intensive protected vegetable cultivation/
Yongqiang Tian, Juan Liu, Xuhui Wang, Lihong Gao

Scientia Horticulturae, Volume 127, Issue 3, 10 January 2011, Pages 198-206, ISSN 0304-4238, DOI: 10.1016/j.scienta.2010.10.011.

(<http://www.sciencedirect.com/science/article/pii/S0304423810004759>)

Abstract:

Continuous cropping under plastic greenhouses, a common practice in intensive Chinese vegetable production systems, has led to the decline of soil productivity and crop yields. A 4-year greenhouse experiment on cucumber double-cropping systems was conducted in Changping country, Beijing, China, to investigate the effects of summer cover crops and residue management on soil microbial biomass carbon (MBC), C mineralization and cucumber yield. The treatments included sweet corn with residue removal after harvest (SR), sweet corn with residue incorporation after harvest (SI), common bean with residue removal after harvest (CR), common bean with residue incorporation after harvest (CI), Garland chrysanthemum and edible amaranth as summer cover crops (GR), and bare fallow during the summer period (Control). The experiment was a randomized complete block design with three replicates. C mineralization was analyzed by trapping the respired CO₂ using air-tight Mason jars containing NaOH vials. After 4 years of the trial, the treatments SR, SI and GR showed significantly ($P < 0.05$) higher levels of potentially mineralized readily available carbon, Ca ([μ]g CO₂-C g⁻¹), than control. The Ca values for residue retention

treatments were significantly related to the biomass inputs for both sweet corn- ($r = 0.981$; $P < 0.01$) and common bean-related ($r = 0.994$; $P < 0.01$) treatments. Generally, the SI and GR treatments showed greater cumulative C mineralization (CCM) than the other treatments. The relatively low CCM:MBC observed for the SI and GR treatments were significantly ($P < 0.05$) related to increased cucumber fruit yields from 2005 to 2008. On the contrary, the CR and CI treatments resulted in significant declines in cucumber fruit yields over the same time periods. The responses of cucumber yields to cover crop treatments were related to the dynamics of soil C. These results suggested that the treatments SI and GR could increase C sequestration and improve soil productivity. Further research is required to test how much loss of C (SOC) occurs from the soil due to the protected cultivation using the in situ testing method.

Keywords: Summer cover crop; Residue management; Greenhouse cucumber; Microbial biomass carbon; Carbon mineralization