ศักยภาพทางอัลลีโลพาทีในดินของใบพืชสกุล *Cinnamomum* บางชนิด

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บทคัดย่อ

ทดสอบศักยภาพทางอัลลีโลพาทีในดินของใบพืชสกุล *Cinnamomum* จำนวน 4 ชนิดในสภาพห้องปฏิบัติการ ได้แก่ กระวาน (*Cinnamomum parthenoxylon* Meissn.) การบูร (*C. camphora* Nees ex Eberm.) อบเชยญวน (*C. loureirii* Nees.) และอบเชยเทศ (*C. zeylanicum* Nees.) และใช้พืชทดสอบ 4 ชนิด ได้แก่ หญ้าขจรจบดอกเล็ก (*Pennisetum polystachyon* (L.) Schult) หญ้ารังนก (*Chloris barbata* Sw.) มะเขือเทศ (*Lycopersicon esculentum* Mill.) และถั่วผี (*Phaseolus lathyroides* L.) โดยนำใบแห้งที่บดละเอียดมาคลุกกับดินขุยไผ่แห้งที่เอาเศษเจือปนออกหมดแล้ว ในอัตราส่วนใบแห้งต่อดินเท่ากับ 1:10 1:20 และ 1:40 โดยน้ำหนัก และใช้ดินที่ไม่คลุกใบพืชเป็นตัวเปรียบเทียบ ให้น้ำทางจานรองจนอิ่มตัว ปลูกเมล็ดพืชทดสอบแต่ละชนิดลงในดินผสมนั้น 20 เมล็ดต่อกระถางที่ความลึก 0.5 เซนติเมตร ตรวจนับความงอกของเมล็ดทุกวันและวัดความยาวลำต้นและรากของต้นกล้าที่ 7 วันหลังเพาะ ใบพืชสกุล *Cinnamomum* ทั้ง 4 ชนิดที่คลุกดินในอัตราส่วนต่าง ๆ มีผลยับยั้งการงอกและการเจริญเติบโตของต้นกล้าพืชทดสอบที่ระดับต่าง ๆ กัน โดยความงอกของเมล็ดได้รับผลกระทบมากที่สุดและความยาวลำต้นได้รับผลกระทบมากกว่าราก ในกลุ่มของพืชทดสอบ พบว่า หญ้ารังนกมีความอ่อนแอต่อใบพืชที่คลุกกับดินมากที่สุด ในใบพืชสกุล *Cinnamomum* ทั้ง 4 ชนิดที่ทดสอบใบการบูรคลุกดินให้ผลการยับยั้งการงอกและการเจริญของต้นกล้าสูงสุด โดยสามารถยับยั้งการงอกของเมล็ดหญ้ารังนกอย่างสมบูรณ์และลดการเจริญของพืชทดสอบอื่น ๆ 50-100% และใบอบเชยญวนคลุกดินมีผลการยับยั้งต่ำที่สุดในการทดลองนี้ ความแตกต่างของศักยภาพทางอัลลีโลพาทีในดินของพืชสกุลนี้ทั้ง 4 ชนิดอาจเกิดจากความแตกต่างทางอัลลีโลพาทีภายในใบพืชแต่ละชนิดเอง หรือเกิดจากความแตกต่างในการเปลี่ยนแปลงของสารอัลลีโลพาทีจากพืชแต่ละชนิดหลังจากที่ปลด-ปล่อยลงในดิน ผลการทดลองนี้ชี้ให้เห็นถึงศักยภาพของใบการบูรในการนำไปประยุกต์ใช้ในการจัดการวัชพืช

คำสำคัญ: อัลลีโลพาที ดิน *Cinnamomum* ความงอกของเมล็ด การเจริญของต้นกล้า

Allelopathic potential of *Cinnamomum* spp. leaves in soil

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Abstract

Study on allelopathic potential of *Cinnamomum* spp. leaves in soil was conducted in laboratory at Faculty of Science, Srinakharinwirot University. Dried ground leaves of 4 *Cinnamomum* spp. (*Cinnamomum parthenoxylon* Meissn., *C. camphora* Nees ex Eberm., *C. loureirii* Nees. and *C. zeylanicum* Nees) were mixed with soil at various leaf: soil ratios (w/w), and 20 seeds of each test plant were grown in separated pot. Seed germinations were checked daily and seedling growths were determined at 7 days after planting. Soil mixed with *Cinnamomum* spp. leaves affected seed germination and seedling growth of test plants at various levels. Seed germination was more sensitive to *Cinnamomum* spp. leaves than seedling growth and shoot growth was found to be more sensitive than root growth. Among test plants used in this study, *Chloris* was the most susceptible plant to all *Cinnamomum* spp. leaves. *C. camphora* leaf mixed with soil showed the highest inhibitory effects on seed germination and seedling growths. In the present study, it completely inhibited *Chloris* seed germination and reduced growth of the other test plant species for 50% to 100%, whereas *C. loureirii* leaf showed the lowest effects. The differences in allelopathic effects in soil of these 4 *Cinnamomum* leaves may be due to the differences in their own allelopathic activity or from the different ability in changing the allelochemicals from each species after released into soil. These results indicated the high potential of *C. camphora* to be applied in agricultural weed management.

Keywords: Allelopathy, *Cinnamomum*, soil, Seed germination, Seedling growth

Introduction

Some allelopathic plants release allelochemicals from root or debris into soil which will be uptaked by the other species and cause allelopathic effect (Ells and Mcsay, 1991; Kong et.al., 2008; Premasthira, and Zungsonthiporn, 1995; Viles and Reese, 1996). The allelochemicals in soil may be degraded, by microbial or non-microbial processes, or adsorbed by soil particles, and the rests will be uptaked by the other plants, and that indicate the allelopathic potential of the compounds (Vidal, Hickman and Bauman, 1998; Weidenhamer and Romeo, 2004; Zhu, Zhang and Ma, 2011). In general, degree of allelopathic effect decreased with the increase of time after plant debris was incorporated into soil (Dabney et al., 1996). *Cinnamomum*, a genus of evergreen aromatic plants belonging to the family Lauraceae, was reported to have allelopathic activity. Water-extract of the dry leaves provided inhibitory effect on seed germination and subsequent seedling growth of some test plants and weeds (Wongwattana and Chamchaiyaporn, 2004). Essential oil of cinnamon (*C. zeylanicum*) was also reported to have high herbicidal activity, and eugenol was determined to be the major compound of this oil (Twarkoski, 2002). Study on allelopathatic potential of these plants leaves in soil on seed germination and subsequent seedling growth of test plants may indicate

the degree of allelopathy of these plants and their potential to be used in agriculture.

Materials and Methods

Leaves of 4 *Cinnamomum* spp. (*Cinnamomum parthenoxylon* Meissn., *C. camphora* Nees ex Eberm., *C. loureirii* Nees. and *C. zeylanicum* Nees) were air-dried, grinded, and kept in refrigerator until used. Soil used in this study (1.64% OM, CEC 49.9 $cmol_c\ kg^{-1}$, pH 6.4) was also air-dried and cleaned up plant residues and other materials. The ground leaf of each species were thoroughly mixed with the 100 g. Soil at the ratios of 1:10, 1:20 and 1:40 (dry leaf: dry soil) and filled into plastic pot (8 cm diameter). Twenty seeds of each test plant comprised *Pennisetum polystachyon* (L.) Schult, *Chloris barbata* Sw., tomato (*Lycopersicon esculentum* Mill.), and *Phaseolus lathyroides* L., were planted into the mixed soils of each pot at 1 cm in depth. The pots were watered from the bottom side until saturated and moved to planting shelf with 3,800 luxes of artificial light, 13–h photoperiod and room temperature. Seed germination was determined daily, shoot and root lengths were measured at 7 days after planting. This experiment was conducted as randomized complete block design with 3 replications, using unmixed soil as untreated control.

Results and Discussion

Dry leaf of *C. parthenoxylon* mixed with soil at all ratios completely inhibited seed germination of *Chloris* at 7 days after planting and also significantly inhibited germination and growth of *Pennisetum*, especially at 1:10 ratio (germination, shoot and root lengths were 48, 33 and 26% of control, respectively) (Figure 1). Seed germinations of tomato and *Phaseolus* in the soil mixtures were in the ranges of 58-30% and 69-51% of control, respectively. Shoot growth of these plants were reduced about 50% at the ratios of 1:20 and 1:10, while the root growth were slightly affected (Figure 1).

Seed germination of *Pennisetum* and *Chloris* were significantly affected in soil mixed with dry *C. camphora* leaf at all mixed ratios, especially *Chloris* seed which were completely inhibited in all ratios (Figure 2). Shoot and root growths of *Pennisetum* in all mixed ratios; were less than 30% of control. *C. camphora* dry leaf mixed with soil at the ratios of 1:20 and 1:10 also completely inhibited seed germination and seedling growth of tomato, and the 1:40 leaf: soil mixture inhibited germination and growth of the test plant more than 50%. *Phaseolus* seed was only moderately affected by *C. camphora* leaf, its germination and shoot growth were reduced about 50% at the highest leaf ratio whereas the root growth was only slightly inhibited (Figure 2).

Among the *Cinnamomum* spp. used in this study, *C. loureirii* dry leaf showed the least effects on germination and growth of all test plants. The leaf: soil mixture at all ratios slightly affected *Pennisetum* seed germination and inhibited germination of *Chloris* about 80% but did not significantly affected subsequent seedling growth of both test plants (Figure 3). In tomato and *Phaseolus*, leaf of this *Cinnamomum* also did not significantly inhibited seed germination and seedling growth, excepted for the 1:10 (leaf: soil) ratio mixture that could inhibit *Phaseolus* shoot growth about 20% (Figure 3). Tomato root growth was promoted by *C. loureirii* leaf at all leaf: soil mixed ratios.

C. zeylanicum dry leaf mixed with soil showed moderate affect on seed germination and seedling growth of test plants (Figure 4). Seed germination and shoot growth of *Pennisetum* and tomato were inhibited by the soil-leaf mixture at the high leaf ratio, whereas their root growths were not significantly affected. *Chloris* seed germination was completely inhibited by the 1:10 mixed ratio whereas the lower leaf ratios (1:20 and 1:40) showed moderate effect on germination and growth of the plant. Germination and shoot growth of *Phaseolus* were significantly affected by *C. zeylanicum* leaf mixed with soil at 1:10 and 1:20 mixed ratios but effects on

root growth were not detected (Figure 4).

The results from the present study indicated that allelochemicals from *Cinnamomum* spp. leaves were released into soil and affected seed germination and seedling growth of the test plants. The similar results were reported in gooseweed, alfalfa and celery (Ells and Mcsay, 1991; Premasthira and Zungsonthiporn, 1995; Shilling et al., 1992). In this study, soil mixed with *C. camphora* leaf showed the highest inhibitory effects on seed germination and seedlings growth and *C. parthenoxylon*, *C. zeylanicum* and *C. loureirii* leaves-soil mixtures exhibited lower effects, respectively. The different in the activity in soil among these 4 species may be explained by 2 possible reasons. First, the high allelopathic activity of *C. camphora* leaf compared with the other 3 species tested, as reported by Wongwattana and Chamchaiyaporn (2004). The second explanation was the difference in microbial or non-microbial changes of the allelochemicals from each species after released into soil (Weidenhamer and Romeo, 2004; Vidal, Hickman and Bauman, 1998). The results of this study on allelopathic potential of *Cinnamomum* spp. leaves in soil, together with the results from the previous study on water extracts of these species leaves (Wongwattana and Chamchaiyaporn, 2004), demonstrated that *C. camphora* leaf has high potential to be applied in agricultural weed management.

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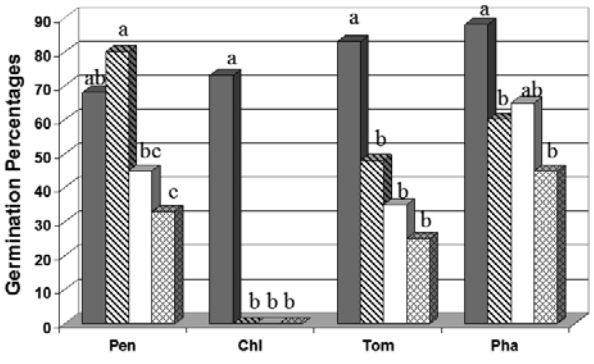

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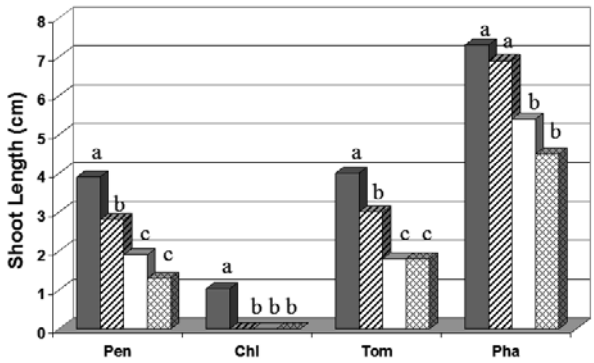

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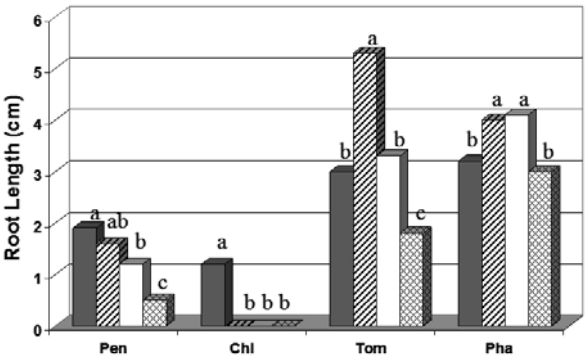
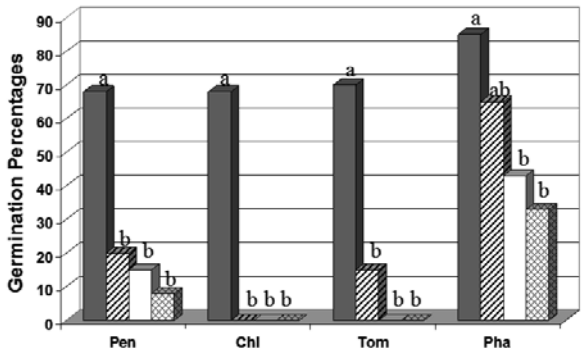


(c)

Figure 1 Effect of *C. parthenoxylon* dry leaf mixed with soil at various ratios on seed germination (a) and subsequent seedling growth (b, c) of test plants 7 day after planting. Pen = *Pennisetum*, Chl = *Chloris*, Tom = Tomato, Pha = *Phaseolus* (Dry leaf: soil ratios; ■, Control; ▨, 1:40; □, 1:20; ▩, 1:10) Means indicated by the same letter in each species are not significantly different by DMRT 0.05.



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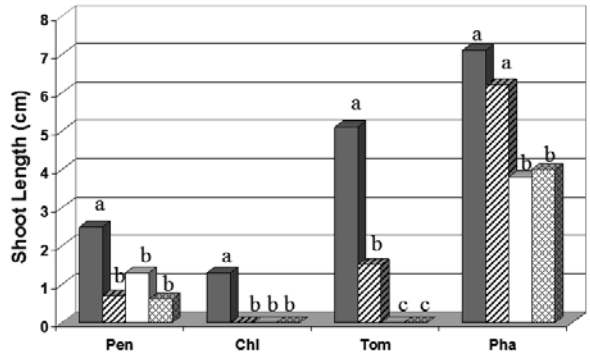

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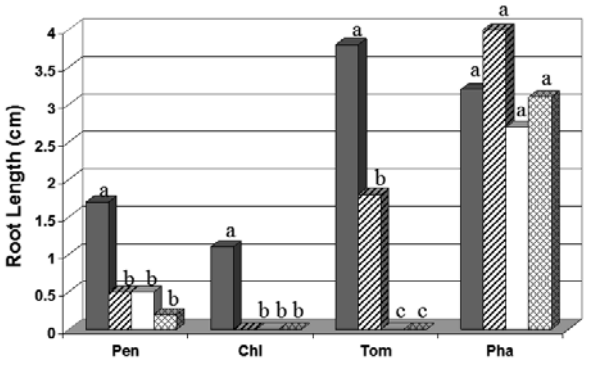

(c)

Figure 2 Effect of *C. camphora* dry leaf mixed with soil at various ratios on seed germination (a) and subsequent seedling growth (b, c) of test plants 7 day after planting. Pen = *Pennisetum*, Chl = *Chloris*, Tom = Tomato, Pha = *Phaseolus*. (Dry leaf: soil ratios; ■, Control; ▨, 1:40; □, 1:20; ▩, 1:10) Means indicated by the same letter in each species are not significantly different by DMRT 0.05.

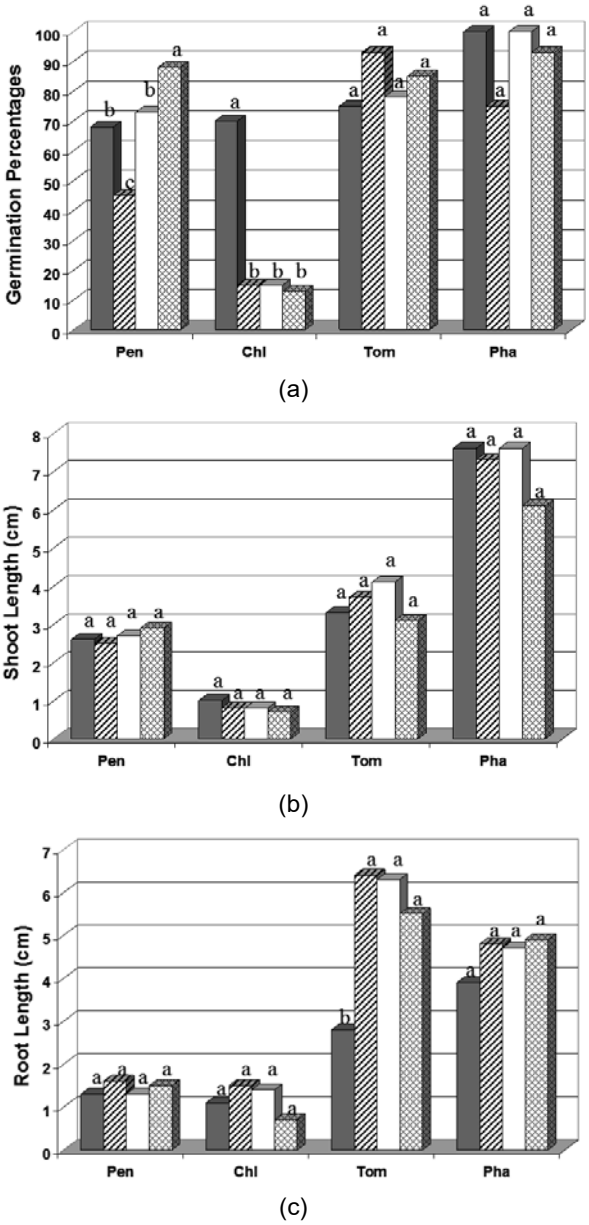

Figure 3 Effect of *C. loureirii* dry leaf mixed with soil at various ratios on seed germination (a) and subsequent seedling growth (b, c) of test plants 7 day after planting. Pen = *Pennisetum*, Chl = *Chloris*, Tom = Tomato, Pha = *Phaseolus*. (Dry leaf: soil ratios; ■, Control; ▨, 1:40; □, 1:20; ▩, 1:10) Means indicated by the same letter in each species are not significantly different by DMRT 0.05.

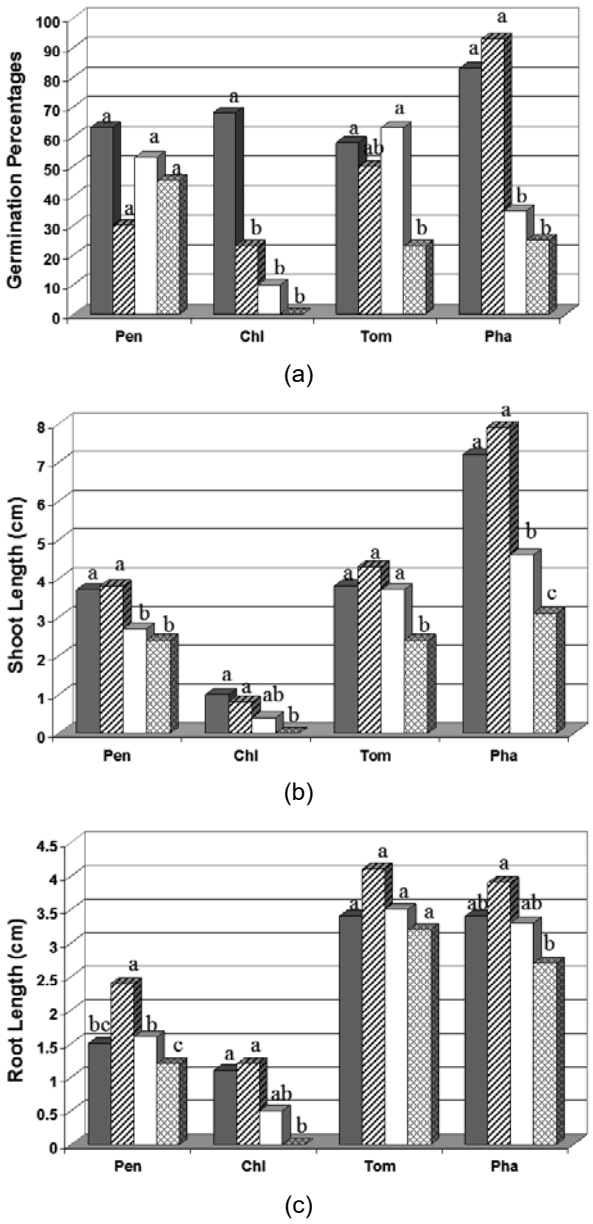

Figure 4 Effect of *C. zeylanicum* dry leaf mixed with soil at various ratios on seed germination (a) and subsequent seedling growth (b, c) of test plants 7 day after planting. Pen = *Pennisetum*, Chl = *Chloris*, Tom = Tomato, Pha = *Phaseolus*. (Dry leaf: soil ratios; ■, Control; ▨, 1:40; □, 1:20; ▩, 1:10) Means indicated by the same letter in each species are not significantly different by DMRT 0.05.