CAUSAL AGENT OF GINGER BACTERIAL WILT IN SABAH AND EFFECT OF *Brassica juncea* var. *rugosa* AS ITS CONTROL

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ABSTRACT

The objectives of this study were to identify the causal agent of Sabah ginger bacterial wilt, to quantify the glucosinolates (GSLs) content in *Brassica juncea* var *rugosa* based on selected growth stage and to evaluate the inhibitory effect of *B. juncea* var *rugosa* against the causal agent of ginger bacterial wilt. The ginger plants with foliar yellowing and wilting symptoms collected from six ginger-growing areas in the Tambunan and Ranau districts were observed to have signs of bacterial pathogen (i.e. bacterial ooze). A total of 19 bacterial strains were isolated, and all of the isolates were characterized as rod-shaped and Gram-negative by Gram-staining and potassium hydroxide test. MALDI-TOF analysis identified six species of the isolates as *Enterobacter cloacae* complex (57.9%), *Ralstonia pickettii* (10.5%), *Agrobacterium tumefaciens* (10.5%), *Bacillus pumilus* (10.5%), *Stenotrophomonas maltophilia* (5.3%) and *Serratia marcescens* (5.3%). In pathogenicity test, *E. cloacae*, which constituted most of the isolates, induced mild rot symptoms (discoloration and decaying) on ginger rhizome slices, but no disease symptoms were produced in ginger plants. The quantification of GSLs content and the dry matter production of *B. juncea* var *rugosa* showed that there was a significant different at the $p<0.05$ between the GSLs concentration and dry matter production at three different growth stages. The highest GSLs concentration (126.55 µmol 100 g^{-1} DM) and dry matter production (18.88 g DM $plant^{-1}$) were obtained at the early senescence stage. In the evaluation of the inhibitory effect of *B. juncea* var *rugosa* against the *E. cloacae*, bioassay analysis showed that there was a significant effect at $p<0.05$ between the *B. juncea* var *rugosa* concentration rate and its inhibitory effect. The highest percentage of inhibition over control was at the highest concentration rate, 4.0 g after 48 hours. However, the inhibitory effect was not able to be replicated when the experiment was conducted in the green house. Difficulties were experienced with the survival of the introduced *E. cloacae* in soil and the *B. juncea* var *rugosa* biofumigation effect could not be evaluated. This study deserved further investigation by future research. In this research, the relationship between *E. cloacae* with the ginger bacterial wilt disease is a first record in Sabah, Malaysia. The locally grown *B. juncea* var *rugosa* was found to have low concentration of GSLs but it had significant inhibition effect on the growth of *E. cloacae* in the *in vitro* condition.

ABSTRACT

AGEN PENYEBAB LAYU BAKTERIA HALIA DI SABAH DAN KESAN Brassica juncea var *rugosa SEBAGAI KAWALANNYA*

Objektif kajian ini adalah untuk mengenalpasti agen penyebab layu bakteria halia di Sabah, menentukan jumlah kandungan glukosinolat (GSLs) dalam Brassica juncea var rugosa pada peringkat pertumbuhan terpilih dan menilai kesan rencatan tanaman B. juncea var rugosa ke atas pertumbuhan agen penyebab layu bakteria halia. Tanaman halia yang daunnya kekuningan dan layu, dari enam kawasan penanaman halia di daerah Tambunan dan Ranau menunjukkan tanda kehadiran patogen bakteria (iaitu rembesan bakteria). Sejumlah 19 strain bakteria diasingkan dan kesemuanya dikategorikan sebagai berbentuk rod dan bakteria Gram negatif melalui ujian Pewarnaan Gram dan kalium hidroksida. Analisis MALDI-TOF mengenalpasti enam spesis bakteria yang diasingkan sebagai Enterobacter cloacae complex (57.9%), Ralstonia pickettii (10.5%), Agrobacterium tumefaciens (10.5%), Bacillus pumilus (10.5%), Stenotrophomonas maltophilia (5.3%) dan Serratia marcescens (5.3%). Ujian kepatogenan mendapati E. cloacae yang merupakan bakteria yang paling banyak diasingkan, menghasilkan simptom reput pada keratan rizom tetapi tidak ada simptom pada pokok halia. Penentuan kuantiti kandungan GSLs dan penghasilan berat kering tanaman B. juncea var rugosa menunjukkan perbezaan yang bererti pada $p<0.05$ di antara kepekatan GSLs dengan penghasilan berat kering pada tiga peringkat pertumbuhan yang berbeza. Jumlah tertinggi direkodkan pada peringkat awal kesenesenan iaitu 126.55 µmol 100 g^{-1} berat kering (GSLs) dan 18.88 g berat kering $pokok^{-1}$ (penghasilan berat kering). Dalam penilaian kesan perencatan tanaman B. juncea var rugosa ke atas pertumbuhan E. cloacae, analisis biocerakin menunjukkan terdapat perbezaan bererti pada $p<0.05$ di antara kadar kepekatan B. juncea var rugosa dengan kesan perencatannya. Perencatan tertinggi berbanding kawalan adalah pada kadar kepekatan tertinggi iaitu 4.0 g selepas 48 jam. Walau bagaimanapun, kesan perencatan tersebut tidak dapat diulangi apabila eksperimen dilaksanakan di rumah hijau. Kesukaran yang dihadapi dari segi kemandirian bakteria yang diinokulasikan dalam tanah, menyebabkan kesan biofumigasi B. juncea var rugosa tidak dapat dinilai. Kajian susulan di masa akan datang diperlukan untuk eksperimen ini. Dalam kajian ini, perkaitan E. cloacae dengan penyakit layu bakteria halia merupakan penemuan pertama di Sabah, Malaysia. Tanaman B. juncea var rugosa didapati mengandungi kepekatan GSLs yang rendah tetapi mempunyai kesan perencatan yang bererti terhadap pertumbuhan E. cloacae dalam keadaan in vitro.