MECHANISM ADAPTATION *Wedelia trilobata* (L.) Hitchc. ON CONDITION OF FLOODING

ABSTRACT

Wedelia trilobata is an invasive plant species. *W. trilobata* could grow in non-clonal and clonal forms. Aggressiveness and invasion ability of *W. trilobata* increased in clonal form. The mechanism of clonal integration that developed in clonal *W. trilobata* supported clonal performance and invasion ability. Like terrestrial plants, *W. trilobata* capable of invading land with different types of flooding includes waterlogged, partial submergence or complete submergence. This showed that *W. trilobata* could adapt to a flooding condition. This study aimed to examine the adaptation mechanism of *W. trilobata* under different types of flooding. The study consisted of three steps: (1) adaptation of non-clonal plants to different types of flooding, (2) clonal growth patterns of *W. trilobata* in a combination of flooding types on the mother ramet and daughter ramet and (3) biomass allocation, relative growth rate , non structural carbohydrate content and hormone content in the sink organ and the relative expression of the *WtSUC2-like* gene in the source organ. The study used a completely randomized design with one factor and consisted of 3 or 5 replications. The factor in the first step was the type of flooding consisting of field capacity (KL), waterlogged (W), partial submergence (Sr) and complete submergence (Sp). The factor in the second step was the combination of flooding types in the mother ramet and daughter ramet. Treatment in the third step included: control, a combination of flooding types which resulted in the highest clonal growth and combination of flooding types which resulted in the lowest clonal growth. The research parameters in the first step included: morphological, anatomical, physiological, metabolic and growth responses. The second and third step parameters were: shoot growth, biomass, biomass allocation, relative growth rate, hormone content, non-structural carbohydrate content and relative expression of the *WtSUC2-like* gene. The results showed that *W. trilobata* which grew non-clonally in waterlogged and partial submergence conditions developed its adaptation including the formation of lenticular hypertrophy, adventitious roots, aerenchyma, retaining photosynthetic pigments and leaf physiology, regulating carbohydrate use and developing hormonal regulation so that growth increased. *W. trilobata* did not develop its adaptive ability during complete submergence resulting in decreased growth. *W. trilobata* which grew clonally in the treatment of flooding types combination between ramets showed the mechanism of clonal integration to improve the performance of daughter ramet, especially in conditions of flooding. The KL-W (field capacity in the mother ramet and waterlogged in the daughter ramet) treatment produced the highest clonal growth and vice versa W-S (waterlogged in the mother ramet and submergence in the daughter ramet) treatment resulted in the lowest clonal growth. Clonal growth of *W. trilobata* was determined by the growth of the daughter ramet. Increased biomass allocation in daughter ramet due

to an increase in the growth of sink organs and the highest allocation of biomass to daughter ramet stolon. Stolon growth in the highest clonal growth (KL-W) was an escape and foraging mechanism in the condition that the daughter ramet experienced waterlogged, while the stolon extension in W-S treatment was an escape mechanism as long as the daughter ramet experienced submergence. The difference in the mechanism of clonal plant adaptation in a combination of flooding types was related to the differences in the relative expression of the *WtSUC2-like* gene in the source organ (leaves).

Keywords: *W. trilobata*, invasive plants, clonal, waterlogged, submergence, *WtSUC2-like* gene

MEKANISME ADAPTASI *Wedelia trilobata* (L.) Hitchc. PADA KONDISI PENGGENANGAN

INTISARI

Endang Saptiningsih

Wedelia trilobata merupakan salah satu jenis tumbuhan invasif. *W. trilobata* dapat tumbuh dalam bentuk non klonal maupun klonal. Agresivitas dan kemampuan invasi *W. trilobata* meningkat dalam bentuk klonal. Mekanisme integrasi klonal yang berkembang pada klonal *W. trilobata* mendukung *performance* klonal dan kemampuan invasinya. Sebagai tumbuhan darat, *W. trilobata* mampu menginvasi lahan yang berbeda tipe penggenangannya meliputi *waterlogged, submergence* parsial atau *submergence* penuh. Hal ini menunjukkan *W. trilobata* dapat beradaptasi pada lahan yang tergenang. Penelitian ini bertujuan untuk mengkaji mekanisme adaptasi *W. trilobata* pada kondisi penggenangan yang berbeda. Pelaksanaan penelitian terdiri dari tiga tahap yaitu: (1) adaptasi tumbuhan non klonal pada tipe penggenangan yang berbeda, (2) pola pertumbuhan klonal *W. trilobata* dalam kombinasi tipe penggenangan pada induk ramet dan anak ramet dan (3) alokasi biomassa, laju pertumbuhan relatif, kandungan karbohidrat non struktural dan kandungan hormon dalam organ *sink* serta ekspresi relatif gen *WtSUC2-like* di organ *source*. Penelitian dilakukan menggunakan rancangan acak lengkap dengan satu faktor dan terdiri dari 3 atau 5 ulangan. Faktor pada tahap pertama adalah tipe penggenangan terdiri dari: kapasitas lapang (KL), *waterlogged* (W), *submergence* parsial (Sr) dan *submergence* penuh (Sp). Faktor pada tahap kedua yaitu kombinasi tipe penggenangan di induk ramet dan anak ramet. Perlakuan di tahap ketiga meliputi: kontrol, kombinasi tipe penggenangan yang menghasilkan pertumbuhan klonal tertinggi dan kombinasi tipe penggenangan yang menghasilkan pertumbuhan klonal terendah. Parameter penelitian di tahap pertama meliputi: respon morfologis, anatomis, fisiologis, metabolik dan pertumbuhan. Parameter tahap kedua dan ketiga yaitu: pertumbuhan tajuk, biomassa, alokasi biomassa, laju pertumbuhan relatif, kandungan hormon, kandungan karbohidrat non struktural dan ekspresi relatif gen *WtSUC2-like*. Hasil penelitian menunjukkan *W. trilobata* yang tumbuh secara non klonal dalam kondisi *waterlogged* dan *submergence* parsial mengembangkan adaptasinya meliputi: pembentukan hipertrofi lentisel, akar adventif, aerenkim, mempertahankan pigmen fotosintesis dan fisiologis daun, mengatur penggunaan karbohidrat dan mengembangkan pengaturan hormonal sehingga pertumbuhan meningkat. *W. trilobata* kurang mengembangkan kemampuan adaptasinya selama *submergence* penuh sehingga mengakibatkan penurunan pertumbuhan. *W. trilobata* yang tumbuh secara klonal dengan perlakuan kombinasi tipe penggenangan antar ramet menunjukkan mekanisme integrasi klonal meningkatkan *performance* anak ramet, terutama dalam kondisi penggenangan. Perlakuan KL-W (kondisi kapasitas lapang di induk ramet dan

waterlogged di anak ramet) menghasilkan pertumbuhan klonal tertinggi dan sebaliknya perlakuan W-S (*waterlogged* di induk ramet dan *submergence* di anak ramet) mengakibatkan pertumbuhan klonal terendah. Pertumbuhan klonal *W. trilobata* ditentukan oleh pertumbuhan anak ramet. Peningkatan alokasi biomassa di anak ramet terjadi karena peningkatan pertumbuhan organ *sink* dan alokasi biomassa tertinggi ditujukan ke stolon anak ramet. Pertumbuhan stolon pada pertumbuhan klonal tertinggi (KL-W) merupakan mekanisme *escape* dan *foraging* dalam kondisi anak ramet mengalami *waterlogged*, sementara pemanjangan stolon pada perlakuan W-S merupakan mekanisme *escape* selama anak ramet mengalami *submergence.* Perbedaan mekanisme adaptasi tumbuhan klonal dalam kombinasi tipe penggenangan berkaitan dengan perbedaan ekspresi relatif gen *WtSUC2-like* di organ *source* (daun).

Keywords*: *W. trilobata*, tumbuhan invasif, klonal, *waterlogged*, *submergence*, gen *WtSUC2-like