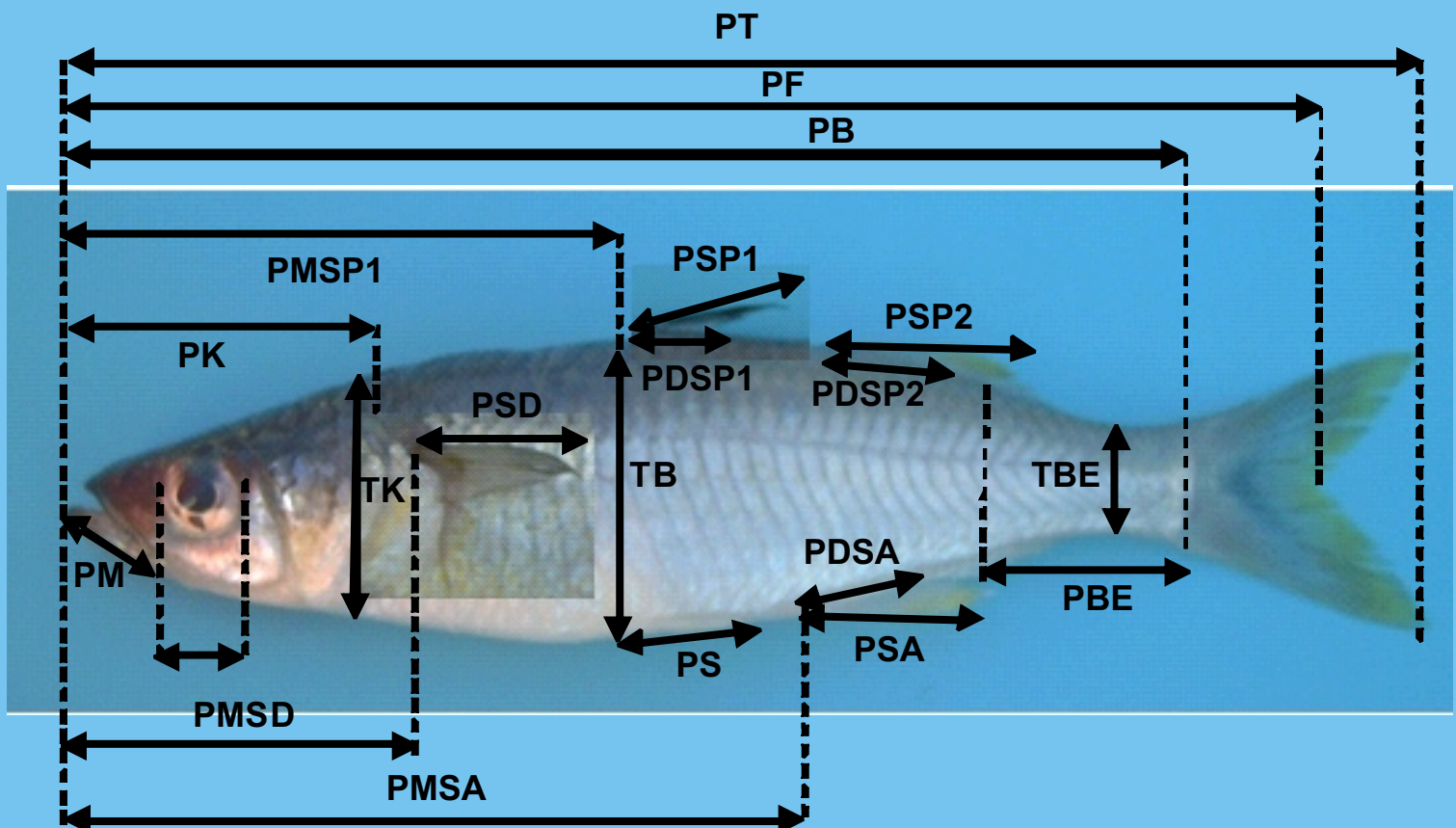


Berita Biologi

Jurnal Ilmu-ilmu Hayati



Berita Biologi merupakan Jurnal Ilmiah ilmu-ilmu hayati yang dikelola oleh Pusat Penelitian Biologi - Lembaga Ilmu Pengetahuan Indonesia (LIPI), untuk menerbitkan hasil karya-penelitian (original research) dan karya-pengembangan, tinjauan kembali (review) dan ulasan topik khusus dalam bidang biologi. Disediakan pula ruang untuk menguraikan seluk-beluk peralatan laboratorium yang spesifik dan dipakai secara umum, standard dan secara internasional. Juga uraian tentang metode-metode berstandar baku dalam bidang biologi, baik laboratorium, lapangan maupun pengolahan koleksi biodiversitas. Kesempatan menulis terbuka untuk umum meliputi para peneliti lembaga riset, pengajar perguruan tinggi maupun pekerjanya-tesis sarjana semua strata. Makalah harus dipersiapkan dengan berpedoman pada ketentuan-ketentuan penulisan yang tercantum dalam setiap nomor.

Diterbitkan 3 kali dalam setahun yakni bulan April, Agustus dan Desember. Setiap volume terdiri dari 6 nomor.

Surat Keputusan Ketua LIPI

Nomor: 1326/E/2000, Tanggal 9 Juni 2000

Dewan Pengurus

Pemimpin Redaksi

B Paul Naiola

Anggota Redaksi

Andria Agusta, Dwi Astuti, Hari Sutrisno, Iwan Saskiawan

Kusumadewi Sri Yulita, Edi Mirmanto

Redaksi Pelaksana

Marlina Ardiyani

Desain dan Komputerisasi

Muhamad Ruslan, Yosman

Sekretaris Redaksi/Korespondensi Umum

(berlangganan, surat-menyurat dan kearsipan)

Enok, Ruswenti, Budiarmo

Pusat Penelitian Biologi-LIPI
Kompleks Cibinong Science Center (CSC-LIPI)

Jln Raya Jakarta-Bogor Km 46,
Cibinong 16911, Bogor - Indonesia
Telepon (021) 8765066 - 8765067

Faksimili (021) 8765059

e-mail: berita.biologi@mail.lipi.go.id
ksama_p2biologi@yahoo.com
herbogor@indo.net.id

Keterangan foto cover depan: Pola pengukuran karakter morfometrik ikan, sesuai makalah di halaman 563
(Foto: koleksi Pusat Penelitian Limnologi-LIPI – Syahroma H Nasution).

Ketentuan-ketentuan untuk Penulisan dalam Jurnal Berita Biologi

1. Makalah berupa karangan ilmiah asli, berupa hasil penelitian (original paper), komunikasi pendek atau tinjauan ulang (review) dan belum pernah diterbitkan atau tidak sedang dikirim ke media lain.
2. Bahasa: Indonesia baku. Penulisan dalam bahasa Inggris atau lainnya, dipertimbangkan.
3. Makalah yang diajukan tidak boleh yang telah dipublikasi di jurnal manapun ataupun tidak sedang diajukan ke jurnal lain. Makalah yang sedang dalam proses penilaian dan penyuntingan, tidak diperkenankan untuk ditarik kembali, sebelum ada keputusan resmi dari Dewan Redaksi.
4. Masalah yang diliput berisikan temuan penting yang mengandung aspek ‘kebaruan’ dalam bidang biologi dengan pembahasan yang mendalam terhadap aspek yang diteliti, dalam bidang-bidang:
 - Biologi dasar (*pure biology*), meliputi turunan-turunannya (mikrobiologi, fisiologi, ekologi, genetika, morfologi, sistematik/ taksonomi dan sebagainya).
 - Ilmu serumpun dengan biologi: pertanian, kehutanan, peternakan, perikanan air tawar dan biologi kelautan, agrobiologi, limnologi, agrobioklimatologi, kesehatan, kimia, lingkungan, agroforestri.
 - *Aspek/ pendekatan biologi* harus tampak jelas.
5. Deskripsi masalah: harus jelas adanya tantangan ilmiah (*scientific challenge*).
6. Metode pendekatan masalah: standar, sesuai bidang masing-masing.
7. Hasil: hasil temuan harus jelas dan terarah.
8. Tipe makalah
Makalah Lengkap Hasil Penelitian (original paper).
Makalah lengkap berupa hasil penelitian sendiri (original paper). Makalah ini tidak lebih dari 15 halaman termasuk gambar dan tabel. Pencantuman lampiran/*appendix* seperlunya. Redaksi berhak mengurangi atau meniadakan lampiran.
Komunikasi pendek (short communication)
Komunikasi pendek merupakan makalah pendek hasil riset yang oleh penelitiannya ingin cepat dipublikasi karena hasil temuan yang menarik, spesifik dan baru, agar lebih cepat diketahui umum. Berisikan pembahasan yang mendalam terhadap topik yang dibahas. Artikel yang ditulis tidak lebih dari 10 halaman. Dalam Komunikasi Pendek Hasil dan Pembahasan boleh disatukan.
Tinjauan kembali (Review)
Tinjauan kembali yakni rangkuman tinjauan ilmiah yang sistematis-kritis secara ringkas namun mendalam terhadap topik riset tertentu. Segala sesuatu yang relevan terhadap topik tinjauan sehingga memberikan gambaran “state of the art” meliputi kemajuan dan temuan awal hingga terkini dan kesenjangan dalam penelitian, perdebatan antarpeleliti dan arah ke mana topik riset akan diarahkan. Perhatikan kecerdasanmu dalam membuka peluang riset lanjut oleh diri sendiri atau orang lain melalui review ini.
9. Format makalah
 - a. Makalah diketik menggunakan huruf Times New Roman 12 point, spasi ganda (kecuali abstrak dan abstract 1 spasi) pada kertas A4 berukuran 70 gram.
 - b. Nomor halaman diletakkan pada sisi kanan bawah
 - c. Gambar dan foto maksimum berjumlah 4 buah dan harus bermutu tinggi. Gambar manual pada kertas kalkir dengan tinta cina, berukuran kartu pos. Foto berwarna akan dipertimbangkan, apabila dibuat dengan computer harus disebutkan nama programnya.
 - d. Makalah diketik dengan menggunakan program Word Processor.
10. Urutan penulisan dan uraian bagian-bagian makalah
 - a. Judul
Judul harus ringkas dan padat, maksimum 15 kata, dalam dwibahasa (Indonesia dan Inggris). Apabila ada subjudul tidak lebih dari 50 kata.
 - b. Nama lengkap penulis dan alamat koresponden
Nama dan alamat penulis(-penulis) lengkap dengan alamat, nomor telpon, fax dan email. Pada nama penulis(-penulis), diberi nomor superskrip pada sisi kanan yang berhubungan dengan alamatnya; nama penulis korespondensi (*correspondent author*), diberi tanda envelop (✉) superskrip. Lengkapi pula dengan alamat elektronik.
 - c. Abstrak dan Kata kunci

- Abstrak dan kata kunci ditulis dalam dwibahasa (Indonesia dan Inggris), maksimum 200 kata, spasi tunggal, tanpa referensi.
- d. Pendahuluan
Berisi latar belakang, masalah, hipotesis dan tujuan penelitian. Ditulis tanpa subheading.
 - e. Bahan dan cara kerja
Apabila metoda yang digunakan sudah baku dan merupakan ulangan dari metoda yang sudah ada, maka hanya ditulis sitiran pustakanya. Apabila dilakukan modifikasi terhadap metoda yang sudah ada, maka dijelaskan bagian mana yang dimodifikasi.
Apabila terdapat uraian lokasi maksi diberikan 2 macam peta, peta besar negara sebagai inset dan peta detil lokasi.
 - f. Hasil
Bagian ini menyajikan hasil utama dari penelitian. *Hasil* dipisahkan dari *Pembahasan*
 - g. Pembahasan
Pembahasan dibuat terpisah dari hasil tanpa pengulangan penyajian hasil penelitian. Dalam Pembahasan hindari pengulangan subjudul dari Hasil, kecuali dipandang perlu sekali.
 - h. Kesimpulan
Kesimpulan harus menjawab pertanyaan dan hipotesis yang diajukan di bagian pendahuluan.
 - i. Ucapan Terima Kasih
Ditulis singkat dan padat.
 - j. Daftar pustaka
Cara penulisan sumber pustaka: tuliskan nama jurnal, buku, prosiding atau sumber lainnya secara lengkap, jangan disingkat. Nama inisial pengarang tidak perlu diberi tanda titik pemisah.
 - i. Jurnal
Premachandra GS, H Saneko, K Fujita and S Ogata. 1992. Leaf Water Relations, Osmotic Adjustment, Cell Membrane Stability, Epicuticular Wax Load and Growth as Affected by Increasing Water Deficits in Sorghum. *Journal of Experimental Botany* **43**, 1559-1576.
 - ii. Buku
Kramer PJ. 1983. *Plant Water Relationship*, 76. Academic, New York.
 - iii. Prosiding atau hasil Simposium/Seminar/Lokakarya dan sebagainya
Hamzah MS dan SA Yusuf. 1995. Pengamatan Beberapa Aspek Biologi Sotong Buluh (*Sepioteuthis lessoniana*) di Sekitar Perairan Pantai Wokam Bagian Barat, Kepulauan Aru, Maluku Tenggara. *Prosiding Seminar Nasional Biologi XI*, Ujung Pandang 20-21 Juli 1993. M Hasan, A Mattimu, JG Nelwan dan M Litaay (Penyunting), 769-777. Perhimpunan Biologi Indonesia.
 - iv. Makalah sebagai bagian dari buku
Leegood RC and DA Walker. 1993. Chloroplast and Protoplast. In: *Photosynthesis and Production in a Changing Environment*. DO Hall, JMO Scurlock, HR Bohlar Nordenkampf, RC Leegood and SP Long (Eds), 268-282. Chapman and Hall. London.
11. Lain-lain menyangkut penulisan
- a. Gambar.
Lebar gambar maksimal 8,5 cm. Judul gambar menggunakan huruf Times New Roman ukuran 8 point.
 - b. Grafik
Untuk setiap perhitungan rata-rata, selalu diberikan standar deviasi. Penulis yang menggunakan program Excell harus memberikan data mentahnya.
 - c. Foto
Untuk setiap foto, harap diberikan skala bila perlu, dan berikan anak panah untuk menunjukkan suatu objek.
 - d. Tabel
Judul tabel harus ringkas dan padat. Judul dan isi tabel diketik menggunakan huruf Times New Roman ukuran 8 point. Seluruh penjelasan mengenai tabel dan isinya harus diberikan setelah judul tabel.
 - e. Gunakan simbol: ○ ● □ ■ △ ▲

- f. Semua nama biologi pada makhluk hidup yang dipakai, pada Judul, Abstrak dan pemunculan pertama dalam Badan teks, harus menggunakan nama yang valid disertai author/descriptor. (Burung Maleo – *Macrocephalon maleo* S. Müller, 1846; Cendana – *Santalum album* L.), atau yang tidak memiliki nama author *Escherichia coli*. Selanjutnya nama-nama biologi disingkat (*M. maleo*, *S. album*, *E. coli*).
 - g. Proof reading
Proof reading akan dikirim lewat e-mail/fax, atau bagi yang berdinasi di Bogor dan Komplek Cibinong Science Center (CSC-LIPI) dan sekitarnya, akan dikirim langsung; dan harus dikembalikan kepada dewan redaksi paling lambat dalam 3 hari kerja.
 - h. Reprint/ cetak lepas
Penulis akan menerima satu copy jurnal dan 3 reprint/cetak lepas makalahnya.
12. Seluruh makalah yang masuk ke meja redaksi Berita Biologi akan dinilai oleh dewan editor untuk kemudian dikirim kepada reviewer/mitra bestari yang tertera pada daftar reviewer BB. Redaksi berhak menjajagi pihak lain sebagai reviewer undangan.
 13. Kirimkan 2 (dua) eksemplar makalah ke Redaksi (lihat alamat pada cover depan-dalam). Satu eksemplar tanpa nama dan alamat penulis (-penulis)nya. Sertakan juga softcopy file dalam CD untuk kebutuhan Referee/Mitra bestari. Kirimkan juga filenya melalui alamat elektronik (e-mail) resmi Berita Biologi: berita.biologi@mail.lipi.go.id dan di-Cc-kan kepada: ksama_p2biologi@yahoo.com, herbogor@indo.net.id
 14. Sertakan alamat Penulis (termasuk elektronik) yang jelas, juga meliputi nomor telepon (termasuk HP) yang dengan mudah dan cepat dihubungi.

Anggota Referee / Mitra Bestari

Mikrobiologi

Dr Bambang Sunarko (*Pusat Penelitian Biologi-LIPI*)
Prof Dr Feliatra (*Universitas Riau*)
Dr Heddy Julistiono (*Pusat Penelitian Biologi-LIPI*)
Dr I Nengah Sujaya (*Universitas Udayana*)
Dr Joko Sulisty (*Pusat Penelitian Biologi-LIPI*)
Dr Joko Widodo (*Universitas Gajah Mada*)
Dr Lisdar I Sudirman (*Institut Pertanian Bogor*)
Dr Ocky Karna Radjasa (*Universitas Diponegoro*)

Mikologi

Dr Dono Wahyuno (*BB Litbang Tanaman Rempah dan Obat-Kemtan*)
Dr Kartini Kramadibrata (*Pusat Penelitian Biologi-LIPI*)

Genetika

Prof Dr Alex Hartana (*Institut Pertanian Bogor*)
Dr Warid Ali Qosim (*Universitas Padjadjaran*)
Dr Yuyu Suryasari Poerba (*Pusat Penelitian Biologi-LIPI*)

Taksonomi

Dr Ary P Keim (*Pusat Penelitian Biologi-LIPI*)
Dr Daisy Wowor (*Pusat Penelitian Biologi-LIPI*)
Prof (Ris) Dr Johanis P Moge (*Pusat Penelitian Biologi-LIPI*)
Dr Rosichon Ubaidillah (*Pusat Penelitian Biologi-LIPI*)

Biologi Molekuler

Prof (Ris) Dr Eni Sudarmonowati (*Pusat Penelitian Bioteknologi-LIPI*)
Dr Endang Gati Lestari (*BB Litbang Bioteknologi dan Sumberdaya Genetik Pertanian-Kemtan*)
Dr Hendig Winarno (*Badan Tenaga Atom Nasional*)
Prof (Ris) Dr I Made Sudiana (*Pusat Penelitian Biologi-LIPI*)
Dr Nurlina Bermawie (*BB Litbang Tanaman Rempah dan Obat-Kemtan*)
Dr Yusnita Said (*Universitas Lampung*)

Bioteknologi

Dr Nyoman Mantik Astawa (*Universitas Udayana*)
Dr Endang T Margawati (*Pusat Penelitian Bioteknologi-LIPI*)
Dr Satya Nugroho (*Pusat Penelitian Bioteknologi-LIPI*)

Veteriner

Prof Dr Fadjar Satrija (*FKH-IPB*)

Biologi Peternakan

Prof (Ris) Dr Subandryo (*Pusat Penelitian Ternak-Kemtan*)

Ekologi

Dr Didik Widyatmoko (*Pusat Konservasi Tumbuhan-LIPI*)
Dr Dewi Malia Prawiradilaga (*Pusat Penelitian Biologi-LIPI*)
Dr Frans Wospakrik (*Universitas Papua*)
Dr Herman Daryono (*Pusat Penelitian Hutan-Kemhut*)
Dr Istomo (*Institut Pertanian Bogor*)
Dr Michael L Riwu Kaho (*Universitas Nusa Cendana*)
Dr Sih Kahono (*Pusat Penelitian Biologi-LIPI*)

Biokimia

Prof Dr Adek Zamrud Adnan (*Universitas Andalas*)
Dr Deasy Natalia (*Institut Teknologi Bandung*)
Dr Elfahmi (*Institut Teknologi Bandung*)
Dr Hertu Dwi Ariesyadi (*Institut Teknologi Bandung*)
Dr Tri Murningsih (*Pusat Penelitian Biologi-LIPI*)

Fisiologi

Prof Dr Bambang Sapto Purwoko (*Institut Pertanian Bogor*)
Prof (Ris) Dr Gono Semiadi (*Pusat Penelitian Biologi-LIPI*)
Dr Irawati (*Pusat Konservasi Tumbuhan-LIPI*)
Dr Nuril Hidayati (*Pusat Penelitian Biologi-LIPI*)
Dr Wartika Rosa Farida (*Pusat Penelitian Biologi-LIPI*)

Biostatistik

Ir Fahren Bukhari, MSc (*Institut Pertanian Bogor*)

Biologi Perairan Darat/Limnologi

Dr Cynthia Henny (*Pusat Penelitian Limnologi-LIPI*)
Dr Fauzan Ali (*Pusat Penelitian Limnologi-LIPI*)
Dr Rudhy Gustiano (*Balai Riset Perikanan Budidaya Air Tawar-KKP*)

Biologi Tanah

Dr Rasti Saraswati (*BB Sumberdaya Lahan Pertanian-Kemtan*)

Biodiversitas dan Iklim

Dr Rizaldi Boer (*Institut Pertanian Bogor*)
Dr. Tania June (*Institut Pertanian Bogor*)

Biologi Kelautan

Prof Dr Chair Rani (*Universitas Hasanuddin*)
Dr Magdalena Litaay (*Universitas Hasanuddin*)
Prof (Ris) Dr Ngurah Nyoman Wiadnyana (*Pusat Riset Perikanan Tangkap-KKP*)
Dr Nyoto Santoso (*Lembaga Pengkajian dan Pengembangan Mangrove*)

DAFTAR ISI

MAKALAH HASIL RISET (ORIGINAL PAPERS)

PIRAMIDA UMUR DAN PENGELOMPOKAN POPULASI IKAN BONTI-BONTI <i>(Paratherina striata)</i> SECARA SPASIAL DI DANAU TOWUTI, SULAWESI SELATAN [Age Pyramids and Population Clustering of Bonti-bonti Fish (<i>Paratherina striata</i>) in Spatial Aspects in Lake Towuti, South Sulawesi] Syahroma Husni Nasution.....	563
KOMPOSISI KIMIA MINYAK ATSIRI PADA BEBERAPA TIPE DAUN TEMBAKAU (<i>Nicotiana tabaccum L.</i>) [Chemical Compound of Essential Oils from Several Types of Tobacco Leaves (<i>Nicotiana tabaccum L.</i>)] Elda Nurnasari dan Subiyakto.....	571
KARAKTERISASI DAN STUDI STABILISASI α-AMILASE <i>Bacillus licheniformis</i> TVII.6 MENGGUNAKAN BAHAN ADITIF [Characterization and Studies on Stabilization of α -Amylase of <i>Bacillus licheniformis</i> TVII.6 using Additives] Puji Lestari, Nur Richana dan Rosmimik.....	581
PATOGENESITAS <i>Streptococcus agalactiae</i> DAN <i>Streptococcus iniae</i> PADA IKAN NILA (<i>Oreochromis niloticus</i>) [Pathogenesitas of <i>Streptococcus agalactiae</i> and <i>Streptococcus iniae</i> in Nile Tilapia (<i>Oreochromis niloticus</i>)] Dudung Daenuri dan Walson Halomoan Sinaga.....	589
KLASIFIKASI VEGETASI GUNUNG ENDUT, TAMAN NASIONAL GUNUNG HALIMUN-SALAK, BANTEN [Vegetation Classification of Mount Endut, Gunung Halimun-Salak National Park, Banten] E.N. Sambas, C. Kusmana, L.B. Prasetyo dan T. Partomihardjo.....	597
RESPON PERTUMBUHAN DAN KETERGANTUNGAN <i>Albizzia saponaria</i> (LOUR.) MIQ TERHADAP INOKULASI FUNGI MIKORIZA ARBUSKULA LOKAL SULAWESI TENGGARA PADA MEDIA TANAH PASCA TAMBANG NIKEL [Response of Growth and Dependency of <i>Albizzia saponaria</i> (Lour.) Miq on Local Arbuscular Mycorrhizae Fungi from Southeast Sulawesi in Post-Nickel Mining Soil] Faisal Danu Tuheteru, Husna dan Asrianti Arif.....	605
KERAGAAN PERTUMBUHAN HIBRIDISASI EMPAT STRAIN IKAN MAS [Growth Performance of Four Strain Carp Hybridization] MH. Fariduddin Ath-thar, Vitas Atmadi Prakoso and Rudhy Gustiano.....	613
HETEROBLASTIC DEVELOPMENT IN SIX SPECIES OF WILD PIPER: <i>Piper baccatum</i> Blume, <i>Piper firmum</i> Blume, <i>Piper majusculum</i> C.DC, <i>Piper miniatum</i> Blume, <i>Piper</i> <i>crocatum</i> Ruiz & Pav. and <i>Piper retrofractum</i> Vahl. Astuti, I.P., E. Munawaroh, E.M.D. Rahayu, P. Aprilianti dan Sumanto.....	621
INDUKSI KALUS DAN EMBRIOGENESIS SOMATIK <i>IN VITRO</i> PADA LAMTORO (<i>Leucaena leucocephala</i>) [<i>In Vitro</i> Callus Induction and Somatic Embryogenesis of <i>Leucaena leucocephala</i>] Yusri Sapsuha, Djoko Soetrisno dan Kustantinah.....	627
KEANEKARAGAMAN JA BAMBU DI PULAU SUMBA [Arbuscular Fungi of Bamboo in Sumba Island] Kartini Kramadibrata.....	635

EKSPLORASI DAN IDENTIFIKASI MIKORIZA INDIGEN ASAL TANAH BEKAS TAMBANG BATUBARA [Exploration and Identification of Indigenous Mycorrhiza of Ex-Coal Mining Soil] <i>Margarettha</i>	641
MORFOLOGI POLEN MARGA <i>Hornstedtia</i> Retz. (<i>Zingiberaceae</i>) DARI SUMATERA DAN IMPLIKASINYA DALAM TAKSONOMI [Pollen Morphology of the Genus <i>Hornstedtia</i> Retz. (<i>Zingiberaceae</i>) from Sumatra and its implication on Taxonomy] <i>Nurainas, Syamsuardi dan Ardinis Arbain</i>	649
EFEKTIFITAS FORMULASI PENGLEPASAN TERKENDALI (FPT) INSEKTISIDA DIMEHIPO TERHADAP PENGGEREK BATANG (<i>Scirpophaga incertulas</i>) PADA TANAMAN PADIDI DAERAH CIOMAS-BOGOR JAWA BARAT [Formulation Efectivity of Controlled Released Dimehipo Insecticides Against Rice Stem borer (RSB) <i>Scirpophaga incertulas</i> in Ciomas - Bogor West Java] <i>Sofnie M. Chairul, I Wayan Laba dan Benni Ernawan</i>	655
STUDI AGRONOMIS DAN MOLEKULER PADI UMUR GENJAH DAN SEDANG [Agronomics and Molecular Study on Early and Intermediate Maturity Rice] <i>Tasliah, Joko Prasetyono, Ahmad Dadang, Masdiar Bustamam dan Sugiono Moeljopawiro</i>	663
GENETIK IKAN BUJUK (<i>Channa lucius</i> Cuvier, Channidae) DARI PERAIRAN SUMATERA BARAT, JAMBI DAN RIAU BERDASARKAN MARKER DNA [Genetic of Snakehead Fish (<i>Channa lucius</i> Cuvier, Channidae) from West Sumatera, Jambi and Riau revealed by DNA Marker] <i>Azrita, Estu Nugroho, Hafrijal Syandri, Dahelmi dan Syaifullah</i>	675
PEMANFAATAN PURUN TIKUS (<i>Eleocharis dulcis</i>) SEBAGAI BIOFILTER PADA SALURAN INLET UNTUK PERBAIKAN KUALITAS AIR MASUK DI LAHAN SULFAT MASAM POTENSIAL [The Utilization Purun Tikus (<i>Eleocharis dulcis</i>) as Biofilter for Improvements Water Quality in Soil Acidic Sulphate] <i>Ani Susilawati dan Achmadi Jumberi</i>	681

HETEROBLASTIC DEVELOPMENT IN SIX SPECIES OF WILD *PIPER*: *Piper baccatum* Blume, *Piper firmum* Blume, *Piper majusculum* C.DC, *Piper miniatum* Blume, *Piper crocatum* Ruiz & Pav. and *Piper retrofractum* Vahl.¹

Astuti IP[✉]*, E Munawaroh, EMD Rahayu, P Aprilianti and Sumanto

Center for Plant Conservation Bogor Botanical Gardens

Indonesian Institute of Sciences

*e-mail : inggit_pa@yahoo.com

ABSTRAK

Heteroblastik pada tanaman adalah adanya bentuk karakter morfologi daun yang sangat berbeda pada fase muda dan fase dewasa, yang terus berlangsung dari fase muda sampai dewasa. Telah dilakukan penelitian tentang perubahan morfologi daun pada tiga jenis sirih (*Piper* spp.) liar yang tumbuh di kawasan Hutan Konservasi Suaka Margasatwa Maninjau Utara-Selatan, Tanjung Raya, Kabupaten Agam, Provinsi Sumatra Barat dan tiga jenis sirih liar koleksi Pusat Konservasi Tumbuhan-Kebun Raya Bogor-LIPI. Dalam penelitian ini, jumlah individu yang diamati dari setiap jenisnya adalah 5 individu muda dan 5 individu dewasa, dengan masing-masing jenis/spesies 5 kali ulangan; sedangkan jumlah spesimen voucher setiap jenisnya adalah 10 spesimen. Data yang dicatat adalah kondisi habitat (di hutan dan di Kebun raya Bogor); lokasi di mana tumbuhan tersebut ditemukan (tepi sungai, tepi jalan, merambat di batu, pohon atau tempat rambatan lainnya). Data lain yang dicatat adalah ukuran daun (lebar dan panjang), bentuk daun pada fase muda dan dewasa. Selain itu juga dicatat karakteristik morfologi daun lainnya. Enam jenis sirih liar (*Piper baccatum*, *P. firmum*, *P. majusculum*, *P. miniatum*, *P. porphyrophyllum* dan *P. retrofractum*) dari kawasan hutan konservasi Suakamargasatwa Maninjau Utara-Selatan dan Kebun Raya Bogor, memiliki perubahan morfologi daun pada fase muda dan fase dewasa yang dikenal dengan sebutan perkembangan heteroblastik.

Kata kunci: Heteroblastik, morfologi perkembangan daun, sirih, *Piper*

ABSTRACT

Heteroblastic plant produces markedly different leaf morphology between juvenile and adult stage. The juvenile stage through heteroblastic development attains the adult stage. This study revealed the morphological changes observed in leaves of three wild *Piper* grow in Suaka Alam Maninjau Utara Selatan forest, Tanjung Raya District, Agam Regency, West Sumatera and three wild *Piper* from Bogor Botanical Gardens collection, from juvenile stage to adult stage. In this research, total individual, observed in each species are 5 individual of juvenile and 5 of adult stage with 5 treatments, while the total voucher in each species are 10 specimens. We recorded their habitat (in and out side the forest, also in Bogor Botanical Gardens), such as where they grow (near the river or road, climbing in the stone or in the trees or in stand boom). Leaf size (width and length) was measured and leaf shape was observed on juvenile and adult stage. We also recorded the other morphological characteristic of the leaves. Six species of wild *Piper* (*P. baccatum*, *P. firmum*, *P. majusculum*, *P. miniatum*, *P. crocatum*, and *P. retrofractum*) from the "Suaka Alam Maninjau Utara Selatan" forest and Bogor Botanical Gardens collection has morphological changes in their leaves which is called heteroblastic development.

Keywords: Heteroblastic, leaf development morphology, *Piper*

INTRODUCTION

There are over 2,000 species of Piperaceae which is known in the tropical and subtropical regions of the world (Kato and Furlan, 2007; Mabberley, 1997). The genus *Piper* include more than 1.000 species, making it one of the largest genera of basal Angiosperms (Kubitzki *et al.*, 1993; Soltis *et al.*, 1999 in Jaramillo and Manos, 2001). Over 400 species recorded growth in the Malesian regions (Tawan *et al.*, 2002). Backer and Bakhuizen (1965) reported that in Java there were 23 species, and in this handbooks they have not explained about the existence of the morphological changes in leaves of these *Piper*

species.

Most members of the genus *Piper* are woody climbers, although some are herbs and few are small trees. Their stem has a conspicuous stout node with one simple leaf on each node (Arunrat *et al.*, 2006). Genus *Piper* shows a considerable structural diversity of leaves and stem (Jaramillo and Manos, 2001; Souza *et al.*, 2004). Morphological studies of vegetative organs of *Piper* are relatively scarce. It is commonly known that in juvenile stage the leaf is cordate, and when it reaches the adult stage, there are morphological changes in size and shape, especially when the plant starts flowering.

¹Diterima: 15 Desember 2011 - Disetujui: 10 Maret 2011

Morphological changes in plant is also known as heteroblasty (Burns and Dawson, 2006; Mundhra and Paria, 2009). Heteroblastic changes in leaf morphology could arise from developmental mechanisms of ontogeny. Heteroblasty could follow a rigid developmental programme, with consistent changes in leaf morphology occurring regardless of the condition plants experience during development (Wells and Pigliucci, in Burns, 2005). Heteroblasty could also be generated entirely by plastic responses of individual leaves to changing environmental conditions as plants grows (Sultan, Zwieniecki *et al.*, in Burns 2005).

Dawson and Lucas in Burns (2005) mentioned, if juvenile and adult leaf morphologies enhance performance under different environmental conditions, and these conditions alternate during development, heteroblasty may help plants cope with environmental heterogeneity. Heteroblasty may also have been advantageous during particular climatic regimes or in reducing herbivory by raptorial and other flightless birds (Greenwood and Atkinson in Gamage and Jesson, 2007).

In the wild *Piper* we observed in “Suaka Alam” Maninjau Utara–Selatan and in Bogor Botanical Gardens collection, they showed the existence of different characters of the leaves between the juvenile and adult stage. The leaves are cordate in juvenile stage, while in adult stage, they become oblong or obovoid - elliptic. The transition between the leaf changes is marked by the production of flower. In the places without direct sunlight, especially in the forest, adult *Piper* spp. will produce fully developed leaves without flower. The objective of this research is to assess the changes in leaves morphological features of wild *Piper* spp.

MATERIALS AND METHODS

Six wild *Piper* observed in this research are *P. baccatum*, *P. firmum*, *P. majusculum*, *P. miniatum*, *P. crocatum* and *P. retrofractum*. Morphological changes was observed in leaves of six wild *Piper*, grow in Suaka Alam Maninjau Utara-Selatan forest, Tanjung Raya District, Agam Regency, West Sumatera and in Bogor Botanical Gardens, from juvenile stage to adult stage. In this research, total individual, observed in each

species are 5 individual of juvenile and 5 of adult stage with 5 treatments, while the total voucher in each species are 10 specimens. We recorded their habitat (in and out side forest, also in Bogor Botanical Gardens), such as where they grow (near the river or road, climbing in the stone or in the trees or in stand boom). Leaf size (width and length) was measured and leaf shape was observed on juvenile and adult stage. We also recorded the other morphological characteristic of the leaves.

RESULT

The morphology of the leaves of angiosperms exhibits remarkable diversity. The changes in the morphology of the leaves are the most conspicuous feature of heteroblastic development in the vascular plant (Mundhra and Paria, 2009). Six wild *Piper* observed in this research showed heteroblastic development. All of the wild *Piper* showed changes in their leaf size and leaf shape from juvenile stage through adult stage. The explanation of heteroblastic development in each species are described as follow:

Piper baccatum

In juvenile stage, it has cordate leaves, but it is very close with triangle shape. When it reaches the adult stage the morphology of the leaves changed into real cordate leaf. Then when the plant is going to produce flower, this plant produce hanging branches, not standing or erect branches. The leaves of *P. baccatum* during juvenile stage is commonly cordate and when it reaches the adult stage, the leaves become intermediate and elliptic. The length of this leaf is 1.5 – 17.5 cm and width 1.2 – 10 cm (Fig. 1).

Piper firmum

In the juvenile stage, it has oval leaves, but when it becomes adult the leaf shape changed into oval – obovate. On this species we also found that the leaves of *P. firmum* increase in size, so the leaves become large. The length of this leaves is 3 – 9.1 cm and width 3 - 8 cm. But when it is the time to produce flowers, the plant will develop branches which standing and the leaves become elliptic with the length 1.7 – 11.5 cm and width 1.3 – 6.4 cm (Fig. 2).

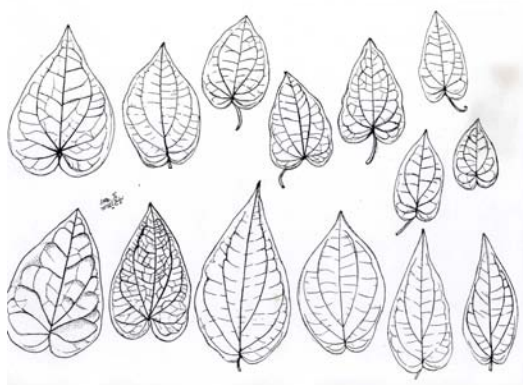


Figure 1. The leaves of *P. baccatum* during juvenile stage (cordate), adult stage (intermediate and elliptic)

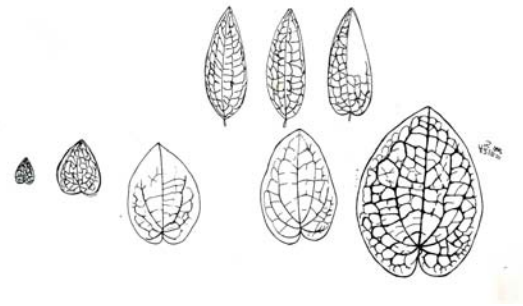


Figure 2. The leaves of *P. firmum* during juvenile stage (oval), adult stage (oval-ovobate)

Piper majusculum

In the juvenile stage, this species has cordate leaf. When the plant reaches the adult stage, it still has cordate leaves, but it is bigger in size than the juvenile one. The length of this leaf is 2 - 15 cm and width 1.8 - 9.5 cm. And on the reproduction stage, *P. majusculum* also produce hanging branches and the leaves become oval to elliptic with more variation in size, length 10 - 32 cm and width 4.5 - 16 cm (Fig. 3).

Piper miniatum

This species also has cordate leaf during the juvenile stage with length 2.7 - 5.1 cm and width 2.6 cm. When it attains the adult stage the leaves become elliptic with length 6.1 - 9.5 cm and width 2.2 - 4.2 cm. And when it is the time to reproduce, the plant will develop hanging branches and the leaves shape still elliptic but the size is smaller length 5 - 5.8 and width 1.6 - 2.1 cm (Fig. 4).

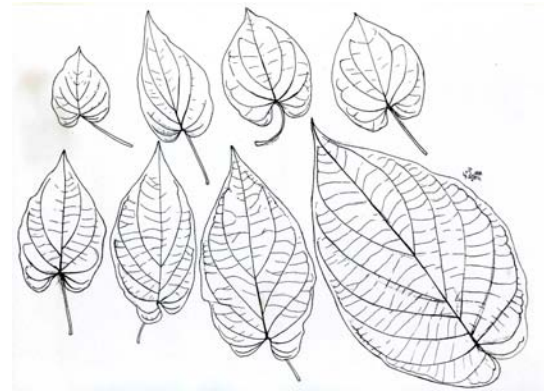


Figure 3. The leaves of *P. majusculum* during juvenile stage (cordate), adult stage (cordate) and at reproduction stage (oval-elliptic)

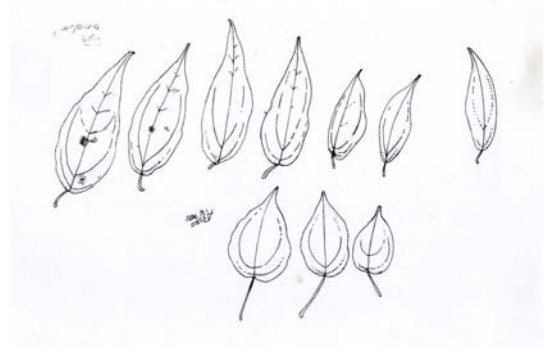


Figure 4. The leaves of *P. miniatum* during juvenile stage (cordate), adult stage (elliptic)

Piper crocatum

It has cordate leaf when it is juvenile. When the plant reaches the adult stage, it still has cordate leaves but the size is bigger than the previous one. This species is also going to develop hanging branches when it will produce flower. The leaf shape is also change, from cordate to elliptic. The length of cordate leaf is 6.1 - 14.6 cm and width 4 - 9.9 cm, while the size of elliptic leaf is 9 - 13.2 cm (length) and 4.1 - 6.8 cm (width) (Fig. 5).

Piper retrofractum

P. retrofractum has cordate shape when it was juvenile and the leaf shape is still the same when it attains adult stage with the leaf length 2.5 - 5.5 cm and width 1.3 - 2.3 cm. But when the plant is going to produce flower, the leaf shape change into elliptical with the leaf length 9 - 15 cm and width 2.8 - 6.6 cm and it also develops hanging branches (Fig. 6).

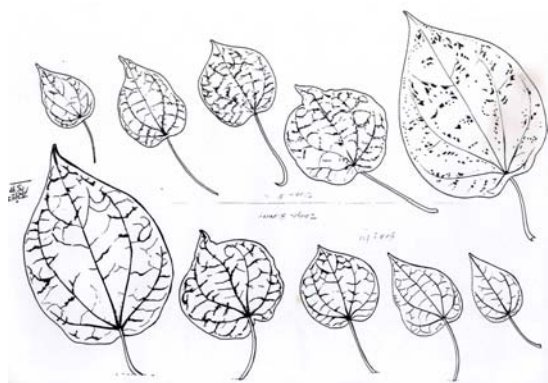


Figure 5. The leaves of *P. crocatum* during juvenile stage (cordate), adult stage (cordate) and at the reproduction stage (elliptic)



Figure 6. The leaves of *P. retrofractum* during juvenile stage (cordate), adult stage (cordate) and at the reproduction stage (elliptic)

DISCUSSION

Heteroblasty in *Piper* is marked by the changes of the leaves between juvenile and adult stage. Based on the data above, we could say *Piper* species commonly have cordate leaf in the juvenile stage. And when it has reached adult stage and is going to flowering the branches will be produced, and the leaf shape will change from cordate to oblong-obovoid-elliptical. In the places without direct sunlight, especially in its natural habitat in Suaka Alam Maninjau Utara – Selatan adult *Piper* will produce fully developed leaves without flowers.

It shows that heteroblasty in *Piper* is not caused by light environment. Other factor that influenced the heteroblasty are climatic regimes and herbivory (Greenwood and Atkinson in Gamage and Jesson, 2007). Morriset and Boutin (1984) also

mentioned that heteroblasty as one of the plasticity that under genetic control. In this research, it is still not known the cause of heteroblasty in *Piper*.

From 6 species of wild *Piper* observed in this research, most of them (5 species i.e. *P. baccatum*, *P. majusculum*, *P. miniatum*, *P. crocatum* and *P. retrofractum*) produce the hanging branches and only *P. firmum* has the standing branches. There is possibility that other closely related species of *Piper* also have heteroblastic development process.

Some of the wild *Piper* species observed showed the similarity of leaf shape when they were in juvenile stage and adult stage, but in adult stage they were slightly larger. This species produce inflorescence on long, vertically oriented stems, which typically extended several meter above the majority of their foliage. Adult leaves were only produced on flowering bearing branches, and were therefore associated with reproductive activity (Burns and Dawson, 2006). Based on the result, there were morphological changes in the leaves of *Piper* spp observed in “Suaka Alam Maninjau Utara – Selatan and in Bogor Botanic Gardens. It showed that the morphological changes in their leaves do not occur by environmental condition such as in shade or open area or plastic responses of individual leaves. Therefore, the morphological changes in leaves of *Piper* spp. could be categorized as heteroblastic, following the term of heteroblastic described by Mundhra and Paria (2009) and Wells and Pigliucci in Burns (2000). This information about the heteroblastic development of leaves on wild *Piper* serves as a marker character and will help in identification of this taxon and distinguish them from other closely related species of the genus.

CONCLUSION

Six species of wild *Piper* (*P. baccatum*, *P. firmum*, *P. majusculum*, *P. miniatum*, *P. crocatum*, and *P. retrofractum*) from the “Suaka Alam Maninjau Utara Selatan” forest and Bogor Botanical Gardens collection have morphological changes in their leaves which is called heteroblastic development.

ACKNOWLEDGEMENT

We are grateful to the DIKTI - LIPI PROJECT

for financial support for carrying out the observation. We are thankful to the Director of the Center for Plant Conservation Bogor Botanical Gardens, Indonesian Institute of Sciences for providing necessary facilities.

REFERENCES

- Arunrat C, P Mokkalum, R Sudmoon and T Tane.** 2006. *Ethnobotany of Genus Piper (Piperaceae) in Thailand*.
- Backer CA and B van den Brink Jr .** 1965. *Flora of Java Volume I*. Groningen NVP Noodhoff. The Netherland.
- Burns KC.** 2005. Plastic heteroblasty in Beach Groundsel (*Senecio laulus*). *New Zealand Journal of Botany* **43**, 665 – 672.
- Burns KC and JW Dawson.** 2006. A morphological comparison of leaf heteroblasty between New Caledonia and New Zealand. *New Zealand Journal of Botany* **44**, 387–396.
- Gamage HK and L Jesson.** 2007. Leaf heteroblasty is not an adaptation shade: seedling and physiological responses to light. *New Zealand Journal of Ecology* **3**, 245–254.
- Jaramillo MA and PS Manos.** 2001. Phylogeny and patterns of floral diversity in the Genus *Piper* (Piperaceae). *American Journal of Botany* **88**, 706-716.
- Kato JM and M Furlan.** 2007. Chemistry and evolution of the Piperaceae. *Pure Appl. Chem.* **79**, 529 – 538.
- Mabberley DJ.** 1997. *The Plant – Book. A Portable Dictionary of the Vascular Plant* 2nd ed. Cambridge University Press.
- Morisset P and C Boutin.** 1984. The Biosystematic Importance of Phenotypic Plasticity. In: *Plant Biosystematic*, 293–306 WF Grant (Ed.). Academic Press, Toronto.
- Mundhra A and ND Paria.** 2009. Heteroblastic expression in leaf of *Phyllanthus uranaria* Linn. *Researcher* **2**, 14–16.
- Souza LA, IS Moscheta and JHG Oliveira.** 2004. Comparative morphology and anatomy of the leaf and stem of *Peperomia dahlstedtii* C.DC., *Ottonia martiana* Miq., and *Piper diospyrifolium* Kunth (Piperaceae). *Gayana Bot.* **61**, 6–17.
- Tawan CS, IB Ipor, BA Fashihuddin and H Sam.** 2002. A brief account on the wild *Piper* (Piperaceae) of the Crocker Range, Sabah. *Asian Review of Biodiversity and Environmental (ARBEC)*.