ISSN 0126-1754
Volume 8, Nomor 5, Agustus 2007
Terakreditasi
SK Kepala LIPI
Nomor 14/Akred-LIPI/P2MBI/9/2006

Berita Biologi

Jurnal Ilmiah Nasional

Diterbitkan Oleh
Pusat Penelitian Biologi - LIPI

Berita Biologi merupakan Jurnal Ilmiah Nasional yang dikelola oleh Pusat Penelitian Biologi-Lembaga Ilmu Pengetahuan Indonesia (LIPI), untuk menerbitkan hasil karya-penelitian 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 (dosen) maupun pekarya-tesis sarjana semua strata. Makalah harus dipersiapkan dengan berpedoman pada ketentuan-ketentuan penulisan yang tercantum dalam setiap nomor.

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

Surat Keputusan Ketua LIPI

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

Dewan Pengurus

Pusat Penelitian Biologi – LIPI
Jl. Ir. H. Juanda 18, PO Box 208, Bogor, Indonesia
Telepon (0251) 321038, 321041, 324616
Faksimili (0251) 325854; 336538
Email: herbogor@indo.net.id

Keterangan foto cover depan: *Biodiversitas* Nepenthes *(kantong semar), salah satu kekayaan hayati hutan hujan tropik Indonesia, sesuai makalah di halaman 335* (Foto: koleksi LIPI–M Mansur).

LIPI
Berita Biologi
Jurnal Ilmiah Nasional

ISSN 0126-1754
Volume 8, Nomor 5, Agustus 2007
Terakreditasi A
SK Kepala LIPI
Nomor 14/Akred-LIPI/P2MBI/9/2006

Diterbitkan oleh
Pusat Penelitian Biologi - LIPI

KATA PENGANTAR

Hasil penelitian di bidang biologi oleh para peneliti kembali dikemas dalam Jurnal Berita Biologi Nomor 5 (Volume 8) ini. Studi keragaman genetik pada varietas lokal kacang hijau dimaksudkan untuk mendapatkan landasan pemuliaan sebagai langkah lanjut pengembangan salah satu komoditi penting Indonesia. Hasil studi menunjukkan adanya keragaman genetik yang cukup luas dari semua karakter kuantitatif yang diamati. Dalam bidang mikrobiologi dilaporkan hasil studi tentang pengayaan fosfat secara hayati melalui pemahaman lanjut komunitas mikroba pengakumulasi glikogen. Selain itu, dalam mikrobiologi pangan, dilaporkan hasil studi fermentasi kecap dengan menggunakan substrat dari beberapa jenis kacang-kacangan dengan ragi mutan, dilakukan untuk melihat kemungkinan penggunaan beberapa jenis kacang-kacangan sebagai bahan dasar untuk pembuatan kecap dengan menggunakan ragi yang berkualitas sebagai stater. Mikrobiologi lingkungan melaporkan hasil studinya tentang akumulasi amonia di perairan yang dipandang sangat berbahaya, diantisipasi dengan studi proses nitrifikasi oleh kultur mikroba untuk upaya pengendaliannya.

Keberadaan dan fungsi kumbang tinja Scarabaeidae (*scarabaeids dungbeetles*) dipandang komponen sangat penting dalam ekosistem hutan tropis; merupakan jenis kunci (*keystone species*), berfungsi sebagai perombak materi organik yang berupa tinja satwa liar (terutama mamalia), burung dan reptil (siklus hara). Juga sebagai penyebar pupuk alam, membantu aerasi tanah, pengontrol parasit dan penyerbuk bunga Araceae. Hasil studi keanekaragamannya di Hutan Taman Nasional Gunung Gede-Pangrango, dilaporkan peneliti zoologi.

Di bidang botani, selain studi genetika kacang hijau tersebut di atas, tentang tumbuhan obat dilaporkan hasil studi secara in vitro pertumbuhan dan perkembangan *Typhonium* (keladi tikus). Pengaruh media dasar terhadap perkembangan embrio somatik kultur meristem jahe juga dijadikan topik riset, dan dilaporkan bahwa pengaruh media dasar yang signifikan terhadap proliferasi kalus embriogenik, dan pendewasaan embrio somatik pada kultur meristem jahe. Demikian pula keanekaragaman genetik jenis tumbuhan obat tradisional, bahan bangunan dan furnitur pulai (*Alstonia scholaris* (L.) R.Br.) dipelajari pula, di mana hasil dendrogram memisahkan 2 klaster yang mengindikasikan adanya pemisahan individu ke dalam kelompok berbeda. Sementara itu, studi keanekaragaman suku Pandanaceae di kawasan Taman Nasional Lore Lindu (Poso, Sulawesi Tengah) juga dilaporkan sebagai rekor khusus, menemukan 6 jenis di kawasan itu. Buah merah (*Pandanus conoideus* Lamarck) dijadikan sebagai kasus dalam kajian etnotaksonomi di kalangan masyarakat tradisional Pegunungan Arfak, Papua, dan menemukan bahwa sistem tata nama buah merah sepadan dengan sistem tata nama ilmiah tumbuhan, sehingga kearifan lokal ini dapat merupakan alternatif dalam pemecahan masalah dalam taksonomi formal (taksonomi tumbuhan). Keanekaragaman *Nepenthes* (kantong semar) di Kalimantan Tengah diungkapkan sebagai salah satu kekayaan biodiversitas Indonesia, dan pesona keragaman tumbuhan karnivora ini kami angkat sebagai maskot cover nomor ini.

Selamat membaca!

Salam iptek,

Redaksi

Ketentuan-ketentuan untuk Penulisan dalam Berita Biologi

1. Karangan ilmiah asli, *hasil penelitian* dan belum pernah diterbitkan atau tidak sedang dikirim ke media lain.
2. Bahasa Indonesia. Bahasa Inggris dan asing lainnya, dipertimbangkan.
3. Masalah yang diliput, diharapkan aspek "baru" dalam bidang-bidang
   - Biologi dasar *(pure biology),* meliputi turunan-turunannya (mikrobiologi, fisiologi, ekologi, genetika, morfologi, sistematik dan sebagainya).
   - Ilmu serumpun dengan biologi: pertanian, kehutanan, peternakan, perikanan ait tawar dan biologi kelautan, agrobiologi, limnologi, agro bioklimatologi, kesehatan, kimia, lingkungan, agroforestri. *Aspek/pendekatan biologi* harus tampak jelas.
4. Deskripsi masalah: harus jelas adanya tantangan ilmiah *(scientific challenge).*
5. Metode pendekatan masalah: standar, sesuai bidang masing-masing.
6. Hasil: hasil temuan harus jelas dan terarah.
7. Kerangka karangan: standar.
   Abstrak dalam bahasa Inggeris, maksimum 200 kata, spasi tunggal, ditulis miring, isi singkat, padat yang pada dasarnya menjelaskan masalah dan hasil temuan. *Hasil* dipisahkan dari *Pembahasan.*
8. Pola penyiapan makalah: spasi ganda (kecuali abstrak), pada kertas berukuran A4 (70 gram), maksimum 15 halaman termasuk gambar/foto; pencantuman Lampiran seperlunya.
   Gambar dan foto: harus bermutu tinggi, gambar pada kertas kalkir (bila manual) dengan tinta cina, berukuran kartu pos; foto berwarna, sebutkan programnya bila dibuat dengan komputer.
9. Kirimkan 2 (dua) eksemplar makalah ke Redaksi (alamat pada cover depan-dalam) yang ditulis dengan program Microsoft Word 2000 ke atas. Satu eksemplar tanpa nama dan alamat penulis (-penulis)nya. Sertakan juga copy file dalam CD (bukan disket), untuk kebutuhan Referee secara elektronik. Jika memungkinkan, kirim juga filenya melalui alamat elektronik (E-mail) Berita Biologi: herbogor@indo.net.id.
10. Cara penulisan sumber pustaka: tuliskan nama jurnal, buku, prosiding atau sumber lainnya selengkap mungkin; sedapat-dapatnya tidak disingkat. Nama inisial pengarang tidak perlu diberi tanda titik pemisah.
    a. Jurnal
       Premachandra GS, Saneko H, Fujita K and Ogata S. 1992. Leaf Water Relations, Osmotic Adjustment, Cell Membrane Stability, Epicutilar Wax Load and Growth as Affected by Increasing Water Deficits in Sorghum. *Journal of Experimental Botany* **43,** 1559-1576.
    b. Buku
       Kramer PJ. 1983. *Plant Water Relationship*, 76. Academic, New York.
    c. Prosiding atau hasil Simposium/Seminar/Lokakarya dan sebagainya
       Hamzah MS dan Yusuf SA. 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, 769-777. M Hasan, A Mattimu, JG Nelwan dan M Litaay (Penyunting). Perhimpunan Biologi Indonesia.
    d. Makalah sebagai bagian dari buku
       Leegood RC and Walker DA. 1993. Chloroplast and Protoplast. Dalam: *Photosynthesis and Production in a Changing Environment.* DO Hall, JMO Scurlock, HR Bohlar Nordenkampf, RC Leegood and SP Long (Eds), 268-282. Champman and Hall. London.
11. Kirimkan makalah serta copy file dalam CD (lihat butir 9) ke Redaksi. Sertakan alamat Penulis yang jelas, juga meliputi nomor telepon (termasuk HP) yang mudah dan cepat dihubungi dan alamat elektroniknya.

Berita Biologi menyampaikan terima kasih kepada
para penilai (referee) Nomor ini

DM Puspitaningtyas *– Pusat Konservasi Tumbuhan, Kebun Raya Bogor -LIPI*
HD Ariesyadi *– Fakultas Teknik dan Lingkungan-Institut Teknologi Bandung*
H Simbolon *– Pusat Penelitian Biologi-LIPI*
H Yulistiyono *– Pusat Penelitian Biologi-LIPI*
IN Sujaya *– Universitas Udayana*
Irawati *– Pusat Konservasi Tumbuhan, Kebun Raya Bogor –LIPI*
JR Witono *– Pusat Konservasi Tumbuhan, Kebun Raya Bogor –LIPI*
M Amir *– Pusat Penelitian Biologi-LIPI*
R Ubaidillah *– Pusat Penelitian Biologi-LIPI*
Rugayah *– Pusat Penelitian Biologi-LIPI*
YS Poerba *– Pusat Penelitian Biologi-LIPI*

DAFTAR ISI

GENETIC VARIABILITY AND HERITABILITY ESTIMATES OF QUANTITATIVE CHARACTERS IN LOCAL MUNGBEAN (*Vigna radiata* (L.) Wilczek) VARIETIES [Keragaman Genetik dan Dugaan Heritabilitas Karakter Kuantitatif pada Varietas Lokal Kacang Hijau (*Vigna radiata* (L) Wilczek)]

Lukman Hakim
Center for Food Crops Research and Development
Jln. Merdeka 147 Bogor, 16111

ABSTRAK

Informasi keragaman genetik dan dugaan heritabilitas karakter kuantitatif pada plasma nutfah varietas lokal kacang hijau sangat diperlukan dalam program pemuliaan. Sebanyak 98 varietas lokal kacang hijau dievaluasi di Kebun Percobaan Cikeumeuh, Bogor pada musim hujan (MH) 2005. Penelitian menggunakan rancangan acak kelompok, 3 ulangan. Tiap varietas ditanam sebanyak 3 baris, dengan panjang barisan 4 m. Jarak tanam 40 x 20 cm, dengan 2 tanaman per lubang. Terdapat keragaman genetik yang cukup luas dari semua karakter kuantitatif yang diamati, kecuali jumlah biji per polong dan panjang polong. Dari semua varietas lokal yang dievaluasi, varietas lokal Demak, Belu, Pati dan Jeneponto mempunyai daya hasil cukup tinggi. Ke empat varietas lokal tersebut mempunyai jumlah polong per tanaman banyak, ukuran biji besar dan berumur cukup genjah. Bobot biji per tanaman, jumlah polong per tanaman dan ukuran biji mempunyai dugaan heritabilitas dan kemajuan genetik yang tinggi. Sedangkan jumlah cabang, panjang polong dan jumlah biji per polong mempunyai dugaan heritabilitas dan kemajuan genetik yang rendah. Tinggi tanaman mempunyai kertagaman genetik yang tinggi disertai dengan dugaan heritabilitas dan kemajuan genetik yang tinggi. Begitu juga untuk umur berbunga dan umur polong masak mempunyai dugaan heritabilitas yang tinggi, namun kemajuan genetik untuk umur berbunga nilainya rendah dan untuk umur polong masak harapan kemajuan genetiknya sedang. Jumlah polong per tanaman, ukuran biji dan bobot biji per tanaman mempunyai keragaman genetik yang tinggi disertai dengan dugaan heritabilitas yang tinggi. Harapan kemajuan genetik yang dapat diperoleh dalam seleksi untuk satu generasi dari ketiga karakter tersebut diperkirakan masing – masing untuk jumlah polong per tanaman sebesar 45,07 %, ukuran biji 41,88 % dan untuk bobot biji per tanaman 37,03 %.

Kata kunci: Varietas lokal kacang hijau (Vigna radiata (L.) Wilczek), keragaman genetik dan heritabilitas, karakter kuantitatif

ABSTRACT

Information of the variability and heritability of quantitative characters on local mungbean germplasm are important for supporting breeding program. A total of 98 local mungbean varieties or accessions were evaluated at Cikeumeuh Experimental Farm, Bogor, during wet season of 2005. The experiment was conducted in a randomized block design with three replications. Each variety was planted in three rows of four meters long. Plant spacing was 40x20 cm, each hill contained two plants. The differences among the varieties were significant for all the characters studied, except for number of seeds per pod and pod length. High yielding varieties were recorded from Demak, Belu, Pati, and Jeneponto. These varieties had a combination of high number of pods per plant, large seed size and early maturity. Seeds weight per plant, pods per plant and seed size had high heritability and expected genetic advance. While the heritability and expected genetic advance for number of branches, pod length, and seeds per pod were all low. Plant height had a high genotypic variance associated with high heritability and high expected genetic advance. Similarly for days to flowering and days to maturity is genotypic in nature with high heritability coupled with a low expected genetic advance for days to flowering and moderate expected genetic advance for days to maturity. Pods per plant, seed size and seed weight per plant had a high genotypic variance associated with high heritability. The genetic advance of these characters predicted that the greatest gain for one generation of selection would be obtained by selection for pods per plant (45.07%), seed size (41.88%) and seed weight per plant (37.03%).

Key words: Local mungbean (*Vigna radiata* (L.) Wilczek) varieties, genetic variability and heritability, quantitative characters

INTRODUCTION

Mungbean is one of important legumes crops in Indonesia. It is an excellent source of easily digestible protein of low flatulence, which complements the staple rice diet in the country. Mungbean is consumed as sprout, noodles, cake, juice, boil dry bean and baby food.

Since 1970 the mungbean harvested area in Indonesia has increases steadily. It amounted to 345.000 ha in 2004, with a production of about 335.000 tons. The main production centers of mungbean are Central Java, East Java, South Sulawesi, North Nusa Tenggara, and North Sumatra (BPS, 2004).

Owing to its short maturity period and favorable almost year round growing condition, mungbean is accepted as an integral part of cropping system. The area under cultivation as a monocrop is in the dry season after the rice harvest, while on dry land mungbean is predominantly grown mixed with maize varieties during the rainy and post rainy season.

Currently, over 142 local mungbean germplasm accessions are being maintain at National Genebank at Research Institute for Biotechnology and Genetic Resources, Bogor (Hakim, 1998).

Identification of superior pure lines from locally available germplasm or from induced variation by hybridization or mutation is the primary objective in breeding program. The superior genotypes are directly released as commercial cultivars or for further used as parents in breeding program (Fernandez and Sundaram, 1987).

Since 1950 about 19 mungbean varieties have been officially released in Indonesia, and two of them (Siwalik and Arto Ijo) derived from local varieties (Suhartina, 2005; Somaatmadja and Sutarman, 1978).

Siemonsma and anwari (1987) reported that a comparison of the local varieties with the rest of the germplasm pool showed comparable variation patterns for most of the observed variables, except flowering date, branching and plant height. The local varieties appeared to be the suitable source for adaptation to intercropping system and relatively well in monocropping (Van den Bosch, 1987; Van den Bosch and Siemonsma *et al*., 1985).

Mansoor *at al*. (2002) reported that local mungbean germplasm possess high morphogenetic variability that is useful for crop improvement program. Genetic improvement in the expression of a quantitative characters is depend upon having germplasm with a range of genetically controlled variability for the trait under consideration. To assess the range of genetic variability in mungbean, germplasm collection were assembled and evaluated (Chowdhury *et al*., 1968, Ahmed *et al*., 1978).

Plants within a random population vary in their expression of a particular quantitative traits due to genetic differences among the plants and to differences in the microclimate surrounding each plant (Veeraswamy and Palanisamy, 1973). The variations described by phenotypic variance. Heritability refers to the proportion of the phenotypic variance that is heritable and hence transmissable to the next generation.

Heritability estimates are utilized in estimating the gain or genetic advance, that may be accomplished by one generation of selection from the mixed population being studied (Empig *et al*., 1970).

The objectives of this experiment are to investigate genetic variability and heritability of quantitative characters of local mungbean varieties. The finding may be usefull for establishing selection in the mungbean breeding program

MATERIALS AND METHODS

A total of 98 local mungbean varieties or accessions were evaluated at Cikeumeuh Experimental Farm, Bogor, during rainy season of 2004/2005. List of the local varieties were used in the present study presented in Table 1. The varieties grown in a randomize block design with three replications. Each variety was planted in three rows of four meters long. Plant spacing was 40 x 20 cm, each hill contained two plants. Basal fertilizer were applied at the rate of 75 kg urea, 150 kg SP36 and

Source	No of accessions	Source	No of accessions
West Nusa Tenggara	23	South East Sulawesi	5
Madura	6	Central Java	13
North Maluku	2	West Java	20
East Nusa Tenggara	10	East Java	2
North Sulawesi	3	Riau	2
South Sulawesi	11	West Kalimantan	1
Total	55	+	43 = 98 accessions

100 kg KCl / ha. At 40 days after sowing, a top dressing of 75 kg urea was applied. Weeding was done three times to eliminate competition. To control insect pests, the plants were sprayed five times (every ten days) with insecticide decis (1 l/ha) and fungicide benomyl (1 kg/ha).

Observation were taken on ten randomly selected plants from each of the variety. Ten agronomic characters were recorded during investigation, such as days to flowering, days to maturity, plant height, number of branches, number of nodes per plant, number of pods per plant, number of seeds per pod, 1000-seed weight (seed size), pod length and seed weight per plant. The mean value of ten plants were used for statistical analysis of the different characters. In order to determine the broad sense heritability estimate and genetic advance for seed yield and yield components, statistical analysis of the data was done as described by Medhi *et al*. (1980).

RESULT

Range of variability

The mean, range of variability and coefficient of variation for different quantitative characters are given in Table 2. The differences among the strains were significant for all the characters studied, except for number of seeds per pod and pod length. For days to flowering and days to maturity the range was 41 to 53 days and 64 to 106 days, with a mean of 47 and 85 days respectively. Local varieties from Demak, Jeneponto (South Sulawesi), Belu (East Nusa Tenggara), Pati and Sampang (Madura) were maturing earlier among the entries. The earliest maturing accession was local Demak of 64 days (Table 3).

Variation with regard to plant height were quite high, ranging from 61.7 to 105.5 cm, with a mean of 83.6 cm and coefficient of variation 45.4 %. Tall accessions were recorded from Ngawi, Bima, Kupang and West Kalimantan, ranged from 97.7 to 105.5 cm. The shorter of plant height was from Pati, Cirebon, Kuningan, Jepara and Batang, ranged from 61.7 to 67.3 cm. He *et al*. (1987) reported that plant height ranged from 51.0 to 164.0 cm, much higher than those used in present investigation.

Characters	Range	Mean	Coefficient of variation (%)
Days to flowering	41 – 53	47	17.86
Days to maturity	64 – 106	85	34.67
Plant height (cm)	61.7 – 105.5	83.6	45.40
Nodes/plant	4 – 15	9.5	21.33
Branches/plant	5 – 13	9	17.60
Pods/plant	18 – 57	37	37.80
Seeds/pod	8 – 14	11	11.73
Pod length (cm)	8.7 – 11.5	10.1	10.41
1000-seed weight/seed size (g)	31.3 – 73.1	52.2	37.11
Seed yield/plant (g)	11.7 – 47.3	29.5	43.63

Acc. no.	Days to maturity	Plant height (cm)	Number of pods/plant	1000-seed weight (g)	Seed yield/ plant (g)
Local Demak	64	71.7	51	73.1	47.3
Local Belu	70	77.5	53	72.8	45.7
Local Pati	67	61.7	49	71.0	40.8
Local Jeneponto	73	71.3	57	70.7	40.7

Number of nodes per plant varied from 5 to 15 nodes, and the mean was 10 nodes. The accessions from west Kalimantan, Ngawi and Kupang had high number of nodes per plant of 11, 13 and 15 nodes respectively, while the smallest number of nodes per plant were recorded by accessions from Jepara and Cirebon (5 nodes per plant).

Number of pods per plant ranging from 18 to 57 pods, with a mean of 37 pods, and coefficient of variation of 37.8 %. Accessions from Pati, Demak, Belu (East Nusa Tenggara) and Jeneponto (South Sulawesi) produced large number of pods per plant of 49, 51, 53 and 57 pods respectively (Table 3).

Number of branches per plant varied from 5 to 13, and the mean was 9 branches. Accessions from Bangkalan (Madura), Bima, Sumbawa and Borong (East Nusa Tenggara) produced greater number of branches. In this study, the varieties with greater number of branches showed had late maturity (> 90 days).

Number of seeds per pod ranged from 8 to 14 seeds, with a mean of 11 seeds. Entries from Sampang (Madura), Bombongan (South Sulawesi), Jepara and Majenang showed had greater number of seeds per pod.

Variation regarding pod length were ranged from 8.7 to 11.5 cm, with a mean of 10.1 cm. Longer pods were noted in the accessions from Kupang, Bangkalan and Ngawi of 10.8, 11.1 and 11.5 cm respectively. In this study has identified that the varieties with longer pods may not possess large number of seeds per pod.

The 1000-seed weight (seed size) ranged from 31.3 to 73.1 grams, with a mean of 52.2 grams. Accessions from Belu and Demak had a largest seed size of 72.8 and 73.1 g/1000 seeds, followed by accessions from Pati and Jeneponto of 70.7 and 71.0 grams respectively. Choi *et al*. (1986) reported variation for 1000-seed weight from 32 to 73 grams, and Lin *et al*. (1987) reported for 1000-seed weight from 33 to 74 grams, comparable with present investigation.

Seed yield per plant ranged from 11.7 to 47.3 grams, with a mean of 29.5 grams, and a coefficient of variation of 43.6 % (Table 2). High yielding accessions were recorded from Demak, Belu, Pati and Jeneponto of 47.3, 45.7, 40.8 and 40.3 grams respectively. These accessions had combination of high number of pods per plant, large seed size and early maturity (Table 3).

Heritability and genetic advance

Variance, heritability and genetic advance for the various quantitative characters are given in Table 4. In this study the heritability estimates and the corresponding values of expected genetic advance for seed weight per plant had the highest (86.50 %), followed by pods per plant (82.91 %) and seed size (80.03 %). However, characters like number of branches, pod

Characters	PV	GV	PCV	GCV	Heritability (h^2)	GA
Days to flowering	23.21	31.41	13.10	10.87	57.73	17.11
Days to maturity	39.73	30.17	11.21	18.25	53.07	23.02
Plant height (cm)	118.67	78.98	31.06	26.09	70.26	47.70
No of nodes per plant	9.21	3.15	79.12	60.09	67.22	53.21
No of branches/plant	63.10	65.18	18.10	20.18	21.06	17.09
No of pods/plant	81.23	52.63	44.20	23.77	82.91	45.07
No of seeds/pod	5.60	8.22	16.71	9.60	27.06	20.21
Pod length (cm)	7.21	5.70	17.03	13.01	24.20	11.73
1000-seed weight / seed size (g)	112.15	48.72	30.52	25.22	80.03	41.88
Seed yield/plant (g)	108.73	41.11	60.15	27.14	86.50	37.03

length, and seeds per pod had low heritability and expected genetic advanced (Table 4).

Plant height has a high genotypic variance (78.98 %) associated with high heritability (70.26 %) and genetic advance (47.70 %). Similarly, most of the variance for days to flowering and days to maturity is genotypic in nature with high heritability of 57.73 % and 53.07 % respectively, coupled with a low expected genetic advance for days to flowering (17.11 %) and moderate genetic advance for days to maturity (23.02 %).

Although the genotypic variance is high (65.18 %) for number of branches per plant, but the character had low heritability (21.06 %) and low expected genetic advance (17.09 %).

Number of nodes per plant had low genotypic variance, but the character has high heritability estimates (67.22) and high expected genetic advance (53.21 %).

Pods per plant, 1000-seed weight (seed size) and seed weight per plant had high genotypic variance (52.63 %, 48.72 % and 41.11 % respectively) associated with very high heritability (82.91 %, 80.03 % and 86.50 %). The genetic advance of these characters predicted that the greatest gain for one generation of selection would be obtained by selection for pods per plant (45.07 %), followed by seed size (41.88 %) and seed weight per plant (37.03 %).

Seeds per pod and pod length had low genotypic variance, (8.22 and 5.70) respectively. Both of these characters were also had low heritability (27.06 and 24.20) and low genetic advance (20.21 % and 11.73 %). Similar finding were observed by Joshi and Kabaria (1973) who reported that seeds per pod had low heritability (12.3 %) with genetic advance was only 5.3 %.

DISCUSSION

Range of variability

Variation regarding days to maturity was quite high, ranging from 60 to 106 days, while coefficient of variation 34.67 %. Mansoor *et al*. (2002) reported that days to maturity ranged from 85 to 110 days, while Ahmed *et.al*. (1978) remarked that maturing mungbean took from 67 to 108 days, with coefficient of variation 37.81 % is comparable with present investigation.

Variation with regard to plant height ranging from 61.7 to 105.5 cm, while coefficient of variation 45.4 %, and variation for number of pods per plant ranged from 18 to 57 pods, with coefficient of variation of 37.8 %.

The high coefficient of variation (cv) for plant height (45.40 %) and pods per plant (37.80 %) suggests the potential to select types with taller plants and high number of pods per plant. Malhotra *et al*. (1974) reported that mungbean genotypes with high grain yield should have sufficient plant height and high pods per plant. Similary, Pandey *et al* (1988) who reported plant height and pods per plant as the most variable characters for selection criteria.

In this study, accessions from Pati, Demak, Belu and Jeneponto had large number of pods per plant with medium plant height (Table 3). Even though these genotypes appear to have a large number of pods per plant, they have to be carefully evaluated in specific environments and their genotypic potential confirmed prior to their used in the breeding program.

The entries from Bangkalan (Madura), Bima, Sumbawa and Borong (East Nusa Tenggara) had greater number of branches (> 10 branches), but these entries show had late maturity (> 90 days). He *et al*. (1987) and Pundir *et al.*, (1992) reported that days to flowering and to maturity strongly positive correlated with plant height and number of branches per plant. This indicates that the early maturing genotypes were shorter plants and possess small number of branches, while late maturing genotypes were taller with large number of branches.

Variation for seed size were quite high (31.3 to 73.1 g/1000 seeds), with coefficient of variation 37.11 %. Accessions from Demak, Belu and Jeneponto had a larger seed size (> 70 g/1000 seeds), with early or medium maturity. This result is comparable with Gupta and Singh (1969) and Shamsuzzaman *et al.* (1983). They reported that seed size negatively correlated with days to flowering and days to maturity. This indicates that the varieties which having larger seed size tended to possess early flowering and maturity.

Seed yield per plant varied from 11.7 to 47.3 grams, with a coefficient of variation of 43.6 %. Local

varieties from Demak, Belu, Pati and Jeneponto produced the highest yield among the entries (> 40 g/ plant) respectively.

Mansoor *et al.* (2002) studied variability in 26 local mungbean for 7 characters. They found considerable variability for most of the characters studied, especially for seed yield per plant. Similar results have also been obtained by Giriraj (1973) who utilized 75 indigenous and 80 exotic varieties.

Poehlman (1991) reported that since yield is a complex traits, yield data base on a single plant could be misleading. Therefore, the range, mean, and coefficient of variation should be viewed along the genotypic variance, heritability and genetic advance.

Heritability and genetic advance

Seed weight per plant, pods per plant, seed size and plant height had a high genotypic variance (41.11, 52.63, 48.72 and 78.98 % respectively) associated with high heritability (86.50, 82.91, 80.33 and 70.26 %) and high genetic advance of 37.03, 45.07, 41.88 and 47.70 % respectively. Similarly for days to flowering and to maturity had high heritability of 57.73 % and 53.07 % respectively, coupled with low expected genetic advance for days to flowering (17.11 %) and moderate genetic advance for days to maturity (23.02 %). This observation is comparable with Bhargava *et al*. (1966) and Ramana and Singh (1987). They reported seed weight per plant and other primary yield components (pods/plant, seed size, and plant height) had high heritability estimates and high expected genetic advance. Similarly for days to flowering and to maturity had high heritability, but expected genetic advance for these characters were moderate.

Although the genotypic variance is low (3.15) for the number of nodes per plant, but the character had high heritability (67.22) and high expected genetic advance (53.21). The nature of variance of this character, and their high heritability estimates and expected genetic advance, suggest that they are governed by genes that are mostly additive in nature. Mass selection can bring about appreciable improvements in these characters.

Seed weight per plant had high heritability (86.50 %), followed by pods per plant (82.91 %), seed size (80.03 %) and plant height (70.26 %). From these data seed weight per plant would be most responsive to selection, and plant height least responsive. Yohe and Poehlman (1975) and Tickoo *et al.* (1987) reported that the primary yield components in mungbean are seed weight per plant, pods per plant and seed size. Yield of the mungbean plant being the product of these components. They suggested these components could be used as selection criteria on mungbean breeding program.

Pod length had low genotypic variance (5.70 %) associated with low heritability (24.20) and low expected genetic advance (11.73 %). Singh (1974) reported that pod length is poorly correlated with seed yield. This character had moderate heritability (38.10 %) and low expected genetic advance (11.0 %). However, Morton *et al*. (1982) reported that the yield and yield components were to be predominantly under the control of loci with additive gene effects.

Broad sense heritability estimates and genetic advance reported for several yield related characters in mungbean. In this study, seed size showed had high genotypic variance (48.72 %) associated with high heritability (80.03 %) and high expected genetic advance (41.88 %). Murty *et al.* (1976) reported the mean heritability for seed size in the 4 experiments ranged from 34.4 to 70.6 %, and mean genetic advance ranged from 33.9 to 49.0 %.

Heritability estimates are relatively large for most of characters studied. Average over the data recorded, heritability ranged from 21.06 % for branches per plant to 86.50 % for seed weight per plant. Genetic advance ranged from 11.73 % for pod length to 53.21 % for number of nodes per plant. The data indicate that improvements in these characters are possible with the genetic material examined.

CONCLUSION

The study has identified that local varieties had a wide ranged in variability, especially for days to maturity, plant height, seed size and seed yield per plant.

Local Demak, Belu (East Nusa Tenggara), Pati and local Jeneponto (South Sulawesi) were the high yielding accessions and had combination of high number of pods per plant, large seed size and early maturity.

Seed weight per plant, number of pods per plant, number of nodes per plant, seed size and plant height had high heritability and high expected genetic advance, but characters like number of branches, pod length and seeds per pod had low heritability and low genetic advance.

Pods per plant, seed size and seed weight per plant had high heritability. The expected genetic advance of these characters predicted that the greatest gain for one generation of selection would be obtained by selection for pods per plant (45.07 %), seed size (41.88 %) and seed weight per plant (37.03 %).

REFERENCES

Ahmed ZU, MAQ Sheikh, AI Khan and AK Kaul. 1978. Evaluation of local, exotic and mutant germplasm of mungbean for varietal characters and grain yield in Bangladesh. *SABRAO Journal* **10**, 40-48.

Bhargava PD, JN Johri, SK Sharma and BN Bhatt. 1966. Morphological and genetic variability in green gram. *Indian Journal of Genetics and Plant Breeding* **26**, 370-373.

BPS (Badan Pusat Statistik). 2004. *Produksi Tanaman Padi dan Palawija di Indonesia*. BPS. Jakarta.

Chowdhury JB, R Kumar, PN Bhat and SN Kakar. 1968. Evaluation of some exotic and indigenous varieties of *Phaseolus aureus* for characters of economic importance. *Punjab Agric. Univ. Journal of Research* **5**, 463-470.

Choi KJ, HK Lim and DK Lee. 1986. Studies on mungbean varieties. Variation in agronomic characteristic of mungbean varieties. Research. *Reports Rural Development. Korea Republic. Crop*. **28**, 162-167.

Chowdhury JB, R Kumar, PN Bhat and SN Kakar. 1968. Evaluation of some exotic and indigenous varieties of *Phaseolus aureus* for characters of economic importance. *Punjab Agric. Univ. Journal of Research* **5**, 463-470.

Empig LT, RM Lantican and PB Escuro. 1970. Heritability estimates of quantitative characters in mungbean (*Phaseolus aureus* Roxb.). *Crop Science* **10**, 240-241.

Fernandez CJ and S Sundaram. 1987. AVRDC Mungbean Improvement Program. *Proceeding of The Second International Mungbean Symposium*, 58-70, AVRDC, Taiwan.

Giriraj K. 1973. Natural variability in green gram (*Phaseolus aureus* Roxb.). *Mysore Journal of Agricultural Science* **7**, 184-187.

Gupta MP and RB Singh. 1969. Variability and correlation studies in green gram (*Phaseolus aureus* Roxb.). *Indian Journal of Agricultural Sciences* **39**, 482-493.

Hakim L. 1998. Pengelolaan dan Pemanfaatan Plasma Nutfah Kacang hijau. *Buletin Plasma Nutfah* **13, (1)**, 34-40.

He X, T He, Y Xiong and C Jiao. 1987. Research and use of mungbean germplasm resources in Hubei, China. *Proceeding of The Second International Mungbean Symposium*, 35 -4, AVRDC, Taiwan.

Lin LF and XZ Cheng. 1987. Introduction and utilization of AVRDC mungbean in China. *Proceeding of The Second International Mungbean Symposium*, 80-87. AVRDC, Taiwan.

Malhotra VV, S Singh and KB Singh. 1974. Yield components in green gram (*Phaseolus aureus* Roxb.). *Indian Journal of Agricultural Sciences* **44**, 136-141.

Mansoor H, M Ubeda, AR Rao and M Wassem. 2002. Evaluation of mungbean germplasm from Bulichistan. Faisalabad Agricultural University. *Journal of Biologycal Science* **2 (1)**, 21-24.

Medhi BN, NM Hazarika and RK Choudhary. 1980. Genetic variability and heritability for seed yield components in green gram. *Tropical Grain Legumes Bulletin* **17**, 32-34.

Morton F, RE Smith and JM Poehlman. 1982. *The Mungbean*. Department of Agronomy and Soil. University of Puerto Rico, Mayaguez.

Murty BK, GJ Patel and BG Jaisani. 1976. Gene action and heritability estimates of some quantitative traits in mungbean. *Gujarat Research Journal* **2**, 1-4.

Pandey K, SS Raguvanshi and SP Singh. 1988. Selection of parameters for different traits in mungbean (*Vigna radiata*). *Harayana Agricultural University Journal Research* **3**, 69-72.

Poehlman JM. 1991. *Genetics of Quantitative Characters. The Mungbean*, 195-222. Westview Press, Boulder, Colorado.

Pundir SR, KR Gupta and VP Singh. 1992. Studies on correlation coefficient analysis in mungbean (*Vigna radiata*). *Harayana Agricultural University Journal Research* **22**, 256-258.

Ramana MV and DP Singh. 1987. Genetic parameters and character associations in green gram. *Indian Journal of Agricultural Sciences* **57**, 661-663.

Shamsuzzaman KM, RH Khan and MA Shaikh. 1983. Genetic variability and characters association in mungbean (*Vigna radiata* (L.) Wilczek). *Bangladesh Journal Agricculture Research* **8**, 1-5.

Siemonsma JS and M Anwari. 1987. Mungbean genetic resources in East Java, Indonesia. *Proceedings of the Second International Mungbean Symposium*, 42-46. AVRDC, Taiwan.

Singh TP. 1974. Components of genetic variance and dominance pattern for some quantitative traits in mungbean (*Phaseolus aureus* Roxb.). *Indian Journal of Genetics and Plant Breeding* **33**, 430-435.

Somaatmadja S and T Sutarman. 1978. Present Status of Mungbean Breeding in Indonesia. *Proceedings of the First International Mungbean Symposium*, 230-232. AVRDC, Taiwan.

Suhartina. 2005. *Deskripsi Varietas Unggul Kacang-kacangan dan Ubi-ubian*. Balai Penelitian Tanaman Kacang-kacangan dan Ubi-ubian. Malang.

Tickoo JL, CS Ahn, HK Chen and S Sundaram. 1987. Utilization of genetic variability from AVRDC Mungbean Germplasm. *Proceedings of the Second International Mungbean Symposium*, 103–110. AVRDC, Taiwan.

Van den Bosch FGJM. 1985. Selection of mungbean for intercropping with maize. *Proceedings of Workshop on Varietal Improvement of Upland Crops in Rice Based Farming Systems*, 41-45, Thailand.

Van den Bosch FGJM. 1987. Indonesian Mungbean landraces. Pure line selection for yield when intercropped with maize. Euphytica **36**, 783-790.

Veeraswamy RR and GA Palanisamy. 1973. Genetic variability in some quantitative characters of Phaseolus aureus Roxb. Madras Agric. Journal. **60**, 9-12.

Yohe JM and JM Poehlman. 1975. Regression, correlations and combining ability in mungbean (*Vigna radiata*). *Tropical Agriculture* **52**, 343-352.