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Performance of Some Mungbean (*Vignna radiate* L. Wilczek) Genotypes under Late Sowing Condition in Egypt

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Abstract: Two field trials were implemented during autumn of 2004 and 2005 seasons at the experimental farm of National Research Centre, Shalakan District, Kalubia Governorate, Egypt. The aim of the work was to study the performance of 4 mungbean genotypes ; 3 imported (VC-15, VC-21 and King) alongside the local variety (Kawmy-1) at different growth stages as well as yield and its components under late sowing condition (1^{St} August) in Egypt. The results indicated that King genotype surpassed the other genotypes in seed yield/fed., no. of seeds/plant, harvest index and 100-seed weight. Moreover it ranked as the first order due to all growth parameters. Results revealed that due to growth characters the 4 genotypes had the same behavior through the period from 21 to 63 DAS. Top of points in most curves due to growth characters was (49-56 DAS) thus it can be a good or suitable time for forage cutting date under late sowing as an alternative method to provide supplemental protein with annual grasses. Generally, all studied varieties gave a suitable seed and straw yield when sowing lately at the 1st. August. whereas, both king and VC-21 varieties gave the highest value of vegetative growth during growth stage and the highest seed and biological yield at the end of growth seasons. so, could be reducing the summer forage gap by sowing these two varieties after harvesting of early summer crops or instead of sowing Nile maize.

Key words: Mungbean, Genotypes, Late Sowing, Growth Analysis, Field.

INTRODUCTION

Mungbean (*Vigna radiate* L. Wilczek) is a newly introduced pulse crop in several countries such as Australia, Pakistan, Thailand and Egypt[6]. It is an important short growth duration (70-90 day) grain legume crop and high nutritive value. It is popular because its nutritional quality where meal is often to babies and convalescents, owing to their high digestibility and protein content (22-24 %). Its sprouts are consumed as a common vegetable in many countries[18,21]. Also, it is consumed in many forms including boiled dry bean as "dahl" (a porridge eaten with rice), bean cake, confectioneries, noodles and green beans[19]. In addition mungbean is rich in vitamins A, B1, B2 and C and niacin as well as minerals such as K, Ca which are necessary for the human body[17].

Mungbean can be successfully grown in a wide range of environments throughout the tropics and subtropics regions. Phoehlman, from his observation of International Mungbean Series (IMN) suggested that a mean temperature of 20 to 22 ºC may be the minimum for productive growth with the mean optimum temperature in the range of 28 to 30 ºC. Lawn[15] reported that varieties of mungbean differ in sensitively to maximum and minimum temperature. Singh, and Singh[22] found that seed yield and components traits differ with season where growth, pods/plant, seeds/pod and yield expressed better in kharif season while 100-seed weight expressed better in spring season. In India, Khairnar *et al.,*[14] evaluated 22 genotypes of mungbean under condition of the kharif season; they found wide variability in most of yield components and grain yield per hectare. Moreover, Twidwel, *et al*.,[24] recorded that delayed mungbean planting date from May to July produced forage higher with 2.2 ton/ha. Under Egyptian condition, Ashour *et al.,*[6] and El-Kramany[12], recorded that some genotypes of mungbean gave a suitable vegetative growth and yields when sown lately around mid of July.

Mungbean is grown principally for its protein rich edible seeds that are used as human food, while its herbage is used as a fodder and green manure[12,20]. As a successful double purpose crop where it can produce a large amount of biomass and recover after grazing to yield abundant seeds[11], it can be used between young trees for four years prior to canopy closure[16]. Also, it can be good forage with cowpea under rainfall conditions[7], in intercropping with sorghum[5], with maize[1]. Producing leguminous crops such as mungbean for forage is considered an alternative method to provide supplemental protein with

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annual grasses[24]. In addition, legumes are typically higher than grasses in concentrations of N, Ca and Mg_2.

Under Autumn Egyptian condition, it is believed that, using new forage/seed legumes crops with high nutritive value such as mungbean may increase forage and seed production and enhance its quality, also helps the farmer to increase the farm productivity per unit area between the summer and winter major crops. So, there is a need to study the growth parameters in mungbean varieties to identify the suitable stage for forage cut to introduce largest amount of biomass with highest dry matter compared to other stages under late sowing conditions.

Therefore, the main object of the current study was evaluating the behavior of four rnungbean genotypes at different growth stages under late sowing condition.

MATERIALS AND METHODS

Two field experiments were conducted during autumn season of 2004 and 2005 at the Experimental Farm of National Research Centre, Shalkan District, Kalubia Governorate to study the performance of four mungbean (*Vigna radiata* (L.) Wilczeck) genotypes under late sowing condition.

The genotypes used were (VC-15 and VC-21) selected from 23 genotypes imported from Asian-Vegetable Research for Development Centre (AVRDC), evaluated and adopted by Field Crops Research Department, National Research Centre, Egypt, the third genotype was King variety which imported from Australia and the fourth was the local variety (Kawmy-1) .

The soil texture of the experimental site was clay and having the following characters: sand 23.91 %, silt 22.27 %, clay 48.82 %, pH 8.42, organic matter 1.68 %, $CaCo_3$ 1.85%, EC 0.67 mmllos/cm^3, and available total N, P and K were 22.00, 16.85 and 228 mg/100 g soil , according to the method described by Chapman and Pratt[8].

The soil was ploughed twice, ridged and divided into plots. During seed preparation, 150 kg/fed calcium super phosphate (15.5% P_2O_5) and 100 kg/fed potassium sulphate (48 % K_2O) were applied.

The materials were sown in a randomized complete block design (RCBD) with four replications in rows 4 meter long, 0.60 meter apart and 6 ridges with total area (14.4 m^2). Hill spacing was 10 cm within the row. Seeds were sown at 3-5 seeds in each hill in the first week of August in both seasons after inoculation by specific strain of *Rhizobium SPP*. Irrigation took place immediately after sowing, then every two weeks intervals according to agronomic practices in the district. Thinning was carried out at 15 days after sowing to secure two plants per hill on both sides of the ridge. Nitrogen was added after thinning at rate of 15 kg N/fed as urea (46%N).

After 21 days from sowing and every week till 63 days after sowing, ten plants were taken at random for each plot to determine the following characters: plant height, number of leaves and branches/plant and dry weights of stems, leaves and total plant (g/plant). According to Watson[25] the following attributes were determined:

- Leaf area (LA) (dm^2/plant)
- Leaf area index (LAI)= ${}_2L_A$-${}_1L_A$/unit ground area
- Leaf area ratio (LAR) = [(${}_1L_A/W_1$) + (${}_2L_A/W_2$)]/2 (dm^2/g)
- Leaf weight ratio (LWR) = [(${}_IL_W$ /W_1) +[(${}_2L_w/W_2$)]/2
- Specific leaf area (SLA) = [(${}_IL_A$ /${}_1L_W$) + (${}_2L_A$ /${}_2L_W$)]/2 (dm^2/g)
- Specific leaf weight (SLA) = [(${}_IL_W$ /${}_1L_A$) + (${}_2L_W$ /${}_2L_A$)]/2 (g/dm^2)
- Relative growth rate (RGR) = (lin ${}_2W$ - lin ${}_1W$)/'${}_2T$-${}_IT$ (g/g/week).
- Crop growth rate (CGR) = (I/P}* (${}_2W$ - ${}_1W$)/${}_2$)T – ${}_1T$ (g/dm^2/week).
- Net assimilation rate (NAR) = [(${}_2W$ – ${}_1W$)/${}_2T$-${}_1T$] [(lin ${}_2L_A$-lin ${}_1L_A$) / (${}_2L_A$-${}_1L_A$)] (g/dm^2/week)

At harvest (90 DAS) ten plants from two central rows from each plot were taken randomly to estimate the yield components. The whole plot was harvested once and threshed to determine seed, straw and biological yields (ton/fed)

Recorded data were analyzed using MSTAT-C software program. A combined analysis of the two seasons was made and the treatments mean were compared by LSD at 5% probability[23].

RESULTS AND DISCUSSIONS

Growth Parameters: Data presented in Fig 1 showed the significant differences between genotypes at different time intervals. It was clear that the four genotypes stems, leaves and total dry weight per plant (g), plant height, number of leaves and branches/plant and leaf area (LA) were increased gradually at one week interval from 21 to 63 days after sowing (DAS). Similar trend was recorded for the above growth characters over the mean of genotypes (Table 1).

The same table cleared that King variety gave the highest value of plant height, number of branches and leaves per plant and dry matter accumulated of plant organs per plant (stems, leaves and whole plant) followed by VC-21, VC-15 and Kawmy-l, respectively.

Data presented in (Fig 2) showed significant differences in growth analysis i.e., LAI, LAR, LWR, SLA, SLW, RGR, CGR and NAR at different time intervals. All genotypes recorded gradual increase in the most of such traits until it reached the peak during the period (49-56 DAS) (T5). Meanwhile the four genotypes exhibited significant increase due to LAI,

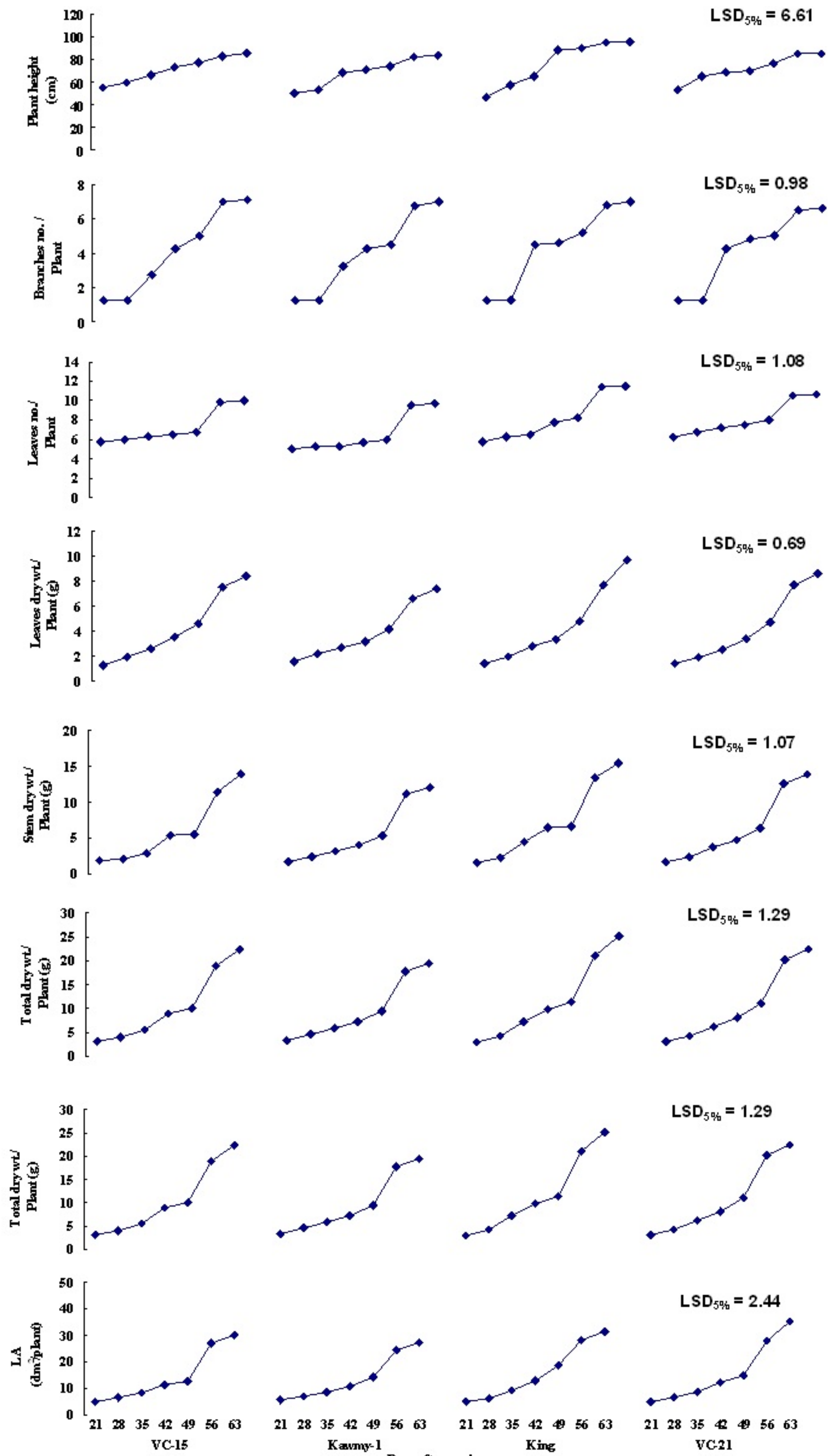

Fig. 1: Effect of mungbean varietal differences on growth parameters at different time intervals.

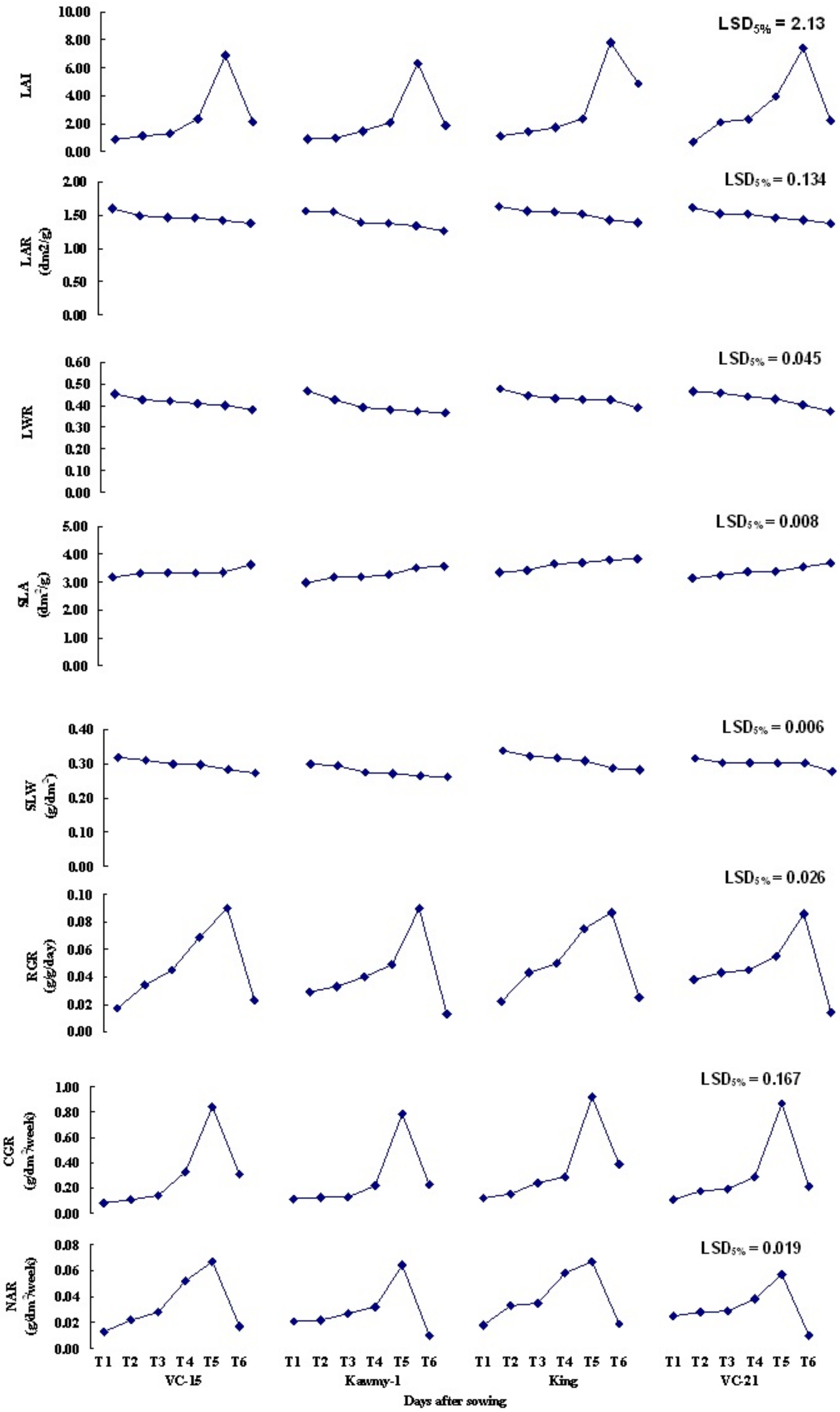

Fig. 2: Effect of mungbean varietal differences on growth analysis at different time intervals. T1=21-28 ; T2=28-35 ; T3=35-42 ; T4= 42-49 ; T5= 49-56 ; T6= 56-63 DAS.

SLA, RGR, CGR and NAR with increasing age of plant from 21 to 56 DAS (T1-T5) then decreased in some traits till 63 DAS except SLA where increased till 63 DAS. On the other hand LAR, LWR and SLW decreased as plant age increased from 21 to 63 DAS (T1 – T6). Similar trend was observed for the above traits over the mean of the four genotypes (Table 2).

Data in the same table cleared that, King variety came in the first order in LAR, LWR, SLA and SLW followed by VC-21, VC-15 and Kawmy-l, respectively. Whereas, no significant differences among the four genotypes were observed in the other growth attributes.

From the previous results it could be concluded that, the genotypes King and VC-21 produced the highest value of dry matter accumulation at different time intervals and ranked in the first order in the most growth parameters as compared to other genotypes. These results may be due to superiority of both genotypes in leaf measurement i.e., number of leaves and branches/plant and LA (Table 1), LAI and LAR, LWR, SLA, SLW, RGR, CGR and NAR (Table 2). These may express to higher adaptation of the two genotypes with environmental conditions of Egypt. Similar results on the varietal differences in growth analysis recorded by several studies under Egyptian conditions[13,9] and in abroad[3].

Yield and its Components: Table 3 showed the varietal differences in yield and yield components. The local variety Kawmy-1 equal significantly with king and VC-15 for producing the highest number of pods/plant and equal with VC-21 and VC-15 due to the greatest number of seeds/pod. While the lowest value of both characters were recorded in VC-21 and King, respectively.

King variety produced the heaviest seed index followed by VC-15, VC-21 and Kawmy-l, respectively. Also, the same table showed significant differences in terms yields/fed (seed, straw and biological) and HI. The genotype King came in the first order in producing the highest seed yield (1.05 ton/fed), followed by Kawmy-1, VC-15 and VC-21, respectively without significant among the last three genotypes. Whereas, the genotypes VC-21 and Kawmy-1 were similar in producing the highest value of straw and biological yields per fed followed by King and VC-15 genotypes, respectively. In term of harvest index (HI) the King variety gave the greatest value followed by VC-15, Kawmy-1, and VC-21, respectively. Insignificant differences among the four genotypes were observed in seed protein content.

From the previous results it could be concluded that, the four genotypes differed in predicting yields per feddan under late sowing condition where, King variety gave the highest seed yield and VC-21 produced the heaviest straw and biological yields. The superiority of King variety in seed yield may be due to it's greater number of branches/plant (Table I), CGR, RGR and NAR (Table 2) and progressive standing in the number of pods/plant, 100 seed weight and harvest index (Table 3) which in turn reflected on seed yield. In addition the highest values of dry matter accumulation of plant organs and LA (Table 1) and LAI (Table 2) led to produce the greatest straw and biological yields of VC-21 genotype. It seems that the superiority of the VC-21 in straw and biological yields and King in seed yield can be attributed to the high adaptability under Egyptian conditions in many regions[10,26].

Generally, all tested genotypes gave a suitable seed (0.68 to 1.05) and straw yields (2.12 - 3.53ton) when sowing was delayed to the 1st of August as well as a suitable dry matter during vegetative growth. These results might be due to be that mungbean can be grown in a wide range of environments throughout the tropics and subtropics[3]. Also, ARC - AVRDC(4) stated that mungbean is considered a warm season crop, and will grow within a mean temperature range of 20 to 40 °C. The mean temperature of 20° to 22 °C may be the minimum and from 28 to 30 °C the optimum for productive growth and yields[4]. Under Egyptian condition, Ashour *et al.,*[5] and El-Krmany[12], recorded that some genotypes of mungbean gave a suitable vegetative growth and yields when sown lately around mid of July. Therefore, these two varieties have more adaptation than other genotypes to Egyptian environment. Moreover Ashour, *et al.,*[5] indicated that superiority of two genotypes in many regions in Egypt.

Conclusion: It could be concluded from data presented in Tables 1, 2 & 3 and illustrated in figures 1& 2 that growth parameters increased with age increase from 21 up to 56 DAS as logical trend, therefore the growth stage of 49 - 56 DAS is a suitable period to cut mungbean as forage with highest canopy and highest dry matter in forage. The data clearly show that King variety can be consider as seed production variety whereas VC-21 can strongly fit as forage crop.

Generally, all studied varieties gave a suitable seed and straw yield when sowing lately at the 1st August. Whereas, both king and VC-21 varieties gave the highest value of vegetative growth during growth stage and the highest seed and biological yield at the end of growth seasons. So, could be reducing the summer forage gap by sowing these two varieties after harvesting of early summer crops or instead of sowing Nile maize. On other words mungbean could be considered as a double purpose (green forage or seeds) in the Egyptian agriculture after harvesting early summer crops and before winter sowing.

Table 1: Some growth parameters of four genotypes of mungbean at different time intervals.

Character / Treatment		Plant ht. (cm)	Number/plant		Dry weight/plant (g)			LA (dm^2/plant)
			Branches	Leaves	Stem	Leaves	Total	
Variety	VC-15	71.42	4.09	7.31	6.17	4.29	10.47	14.36
	Kawmy-1	68.96	3.89	6.63	5.72	3.89	9.70	13.92
	King	76.80	4.37	8.21	7.20	4.54	11.75	15.90
	VC-21	71.85	4.24	8.12	6.48	4.33	10.81	15.70
LSD $_{5\%}$		2.50	0.37	0.41	0.41	0.26	0.49	0.92
Days after sowing (DAS)	21	51.25	1.25	5.69	1.72	1.43	3.15	5.04
	28	58.81	1.25	6.08	2.30	2.01	4.31	6.51
	35	67.13	3.69	6.31	3.58	2.66	6.24	8.61
	42	75.55	4.48	6.86	4.16	3.88	8.54	11.72
	49	79.36	4.93	7.25	5.98	4.58	10.56	15.04
	56	86.31	6.78	10.31	12.16	7.39	19.55	26.84
	63	87.40	6.83	10.46	13.86	8.56	22.42	31.01
LSD $_{5\%}$		3.30	0.49	0.54	0.54	0.34	0.65	1.22

Table 2: Some growth attributes of four genotypes of mungbean at different time intervals.

Character / Treatment		LAI	LAR (dm^2/g)	LWR	SLA (dm^2/g)	SLW (g/dm^2)	RGR (g/g/week)	CGR (g/dm^2/week)	NAR (g/dm^2/week)
Variety	VC-15	2.44	1.47	0.416	3.35	0.296	0.046	0.302	0.033
	Kawmy-1	2.27	1.42	0.401	3.27	0.277	0.042	0.267	0.029
	King	3.22	1.51	0.434	3.63	0.308	0.054	0.353	0.038
	VC-21	3.13	1.49	0.428	3.39	0.301	0.047	0.307	0.031
LSD $_{5\%}$		Ns	0.06	0.018	0.003	0.002	Ns	Ns	Ns
Days after sowing (DAS)	21	0.90	1.60	0.466	3.16	0.318	0.027	0.106	0.019
	28	1.41	1.53	0.439	3.29	0.307	0.038	0.142	0.026
	35	1.71	1.48	0.422	3.38	0.297	0.045	0.176	0.031
	42	2.68	1.45	0.413	3.42	0.294	0.062	0.280	0.045
	49	7.11	1.41	0.402	3.55	0.283	0.088	0.856	0.064
	56	7.78	1.35	0.378	3.68	0.274	0.019	0.284	0.014
LSD $_{5\%}$		1.06	0.07	0.022	0.004	0.003	0.013	0.083	0.009

Table 3: Yield and its components of four mungbean genotypes.

Character / Treatment		Number of		100-seed wt. (g)	Yields (ton/fed.)			HI (%)	Seed protein (%)
		Pods/plant	Seeds/pod		Seed	Straw	Biological		
Veriety	VC-15	23.75	10.25	5.14	0.695	2.12	2.81	18.00	23.2
	Kawmy-1	25.50	10.75	3.28	0.707	3.53	4.24	14.00	23.5
	King	25.00	8.75	6.28	1.051	2.24	3.29	25.00	24.6
	VC-21	17.25	10.25	4.67	0.681	3.56	4.24	13.00	23.8
LSD at 5% level		5.52	1.46	0.05	0.021	0.021	0.020	0.020	ns

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