World Journal of Agricultural Sciences 8 (3): 303-308, 2012
ISSN 1817-3047

Performance and Growth Analysis in Mash Bean Genotypes

Pushp Sharma, H.S. Sekhon and T.S. Bains

Department of Plant Breeding and Genetics,
Punjab Agricultural University, Ludhiana 141004, India

Abstract: Analysis of yielding ability and growth patterns of mash bean (*Vigna mungo* L.Hepper.) genotypes were carried out on loamy sand soil during *kharif* season. Genotypic differences were observed with respect to extent of flower production/shedding, podding and crop durations. Plants of Mash338 were dwarf, erect, compact with determinate growth habit whereas Mash1-1 were tall, spreading with indeterminate growth. Dry matter assimilation in leaves was almost double in Mash1-1 at 60DAS. Dry weight of nodules was highest at 60DAS but the number was higher at 45DAS. Leaf area was highest at 60DAS and chlorophyll content at 45DAS in both the cultivars. Crop growth rates were maximum at (45-60) DAS. Yield of Mash338 was 1676 Kg/ha with HI of 27.4% exhibiting efficient assimilates partitioning. Pods/plant and seeds/pod showed highly positive correlation with yield (r=0.985).

Key words: Assimilates · Leaf area · Chlorophyll · Crop growth rates

INTRODUCTION

Black gram (*Vigna mungo* L.Hepper) commonly known as urdbean in India, is a self pollinating diploid crop with a rich source of protein (20.8 to 30.5%) and carbohydrate (56.5 to 63.7%).Mash bean belongs to family Leguminosae sub-family Papilionatae. The crop not only fixes atmospheric nitrogen but also enriches the soil with N for the growth of succeeding crops according to Sen. [1]. Worldwide yield of mash bean is very poor. It is least researched crop among pulses despite its high nutritive and economic value due to which its area of cultivation and production have both gradually decreased. Grain yield is a very complex character and selection based on grain yield only is not very effective. The physiological inbuilt of plant contribute effectively towards yield. Therefore identification of important physiological parameters at different growth stages will help in developing a suitable breeding strategy for new and efficient genotypes, suited to different climatic conditions as reported by Singh *et al.* [2]. So the present study was carried out to assess the performance of mash bean genotypes in terms of source-sink relationship, nodulation, leaf characteristics, crop growth parameters and dry matter accumulation in relation to yield potentials.

MATERIALS AND METHODS

Two cultivars of mash bean were sown in the field at Punjab Agricultural University during the *Kharif* season in the second week of July from 2003 to 2005 according to the recommendation of package of practices along with the protection measures in the random block design with the six replications of plot size 4x2.4m for each genotype. During the crop growth and development, periodic data was recorded for plant height, number of leaves, nodules and branches per plant. Flower drop was recorded on area basis. Dry matter accumulation into different plant parts viz. root, shoot and leaves was noted at 30,45, 60 and 75 DAS. For growth analysis mean accumulated plant weight(biological yield),mean leaf area and mean dry matter of different plant organs (except roots) including weight of the economically important parts were obtained covering all the growth phases (from 35 to75 days after sowing at 15 days intervals)and used to calculate relative growth rate (RGR, mg mg^{-1} 15 day^{-1}), net assimilation rate (NAR, mg cm^2 15 day^{-1}), crop growth rate(CGR, mg cm^2 15 day^{-1}) leaf weight ratio (LWR, m^2 g^{-1}), leaf shoot ratio (LSR), leaf area ratio (LAR, m^2 g^{-1}), specific leaf weight (SLW, g m^{-2}) specific leaf area(SLA, m^2 g^{-1}) and leaf area index (LAI) by applying formulae proposed by Radford (3). Chlorophyll content estimated by the method of

Corresponding Author: Pushp Sharma, Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana, India

Hiscox and Isralisim [4]. Yield components and yield was recorded at the time of harvest and the data was analyzed statistically.

RESULTS AND DISCUSSION

Flowering Behavior: Initiation of flowering was early in Mash338.This variety flowered 12days earlier than Mash1-1.Flowering duration was more in Mash338 by almost 5 days than the Mash1-1.Podding duration was34 days in Mash338 and 29.8 days for Mash1-1. Flower drop on area basis was lower in Mash1-1 and this variety matured 8 days after Mash338. The reproductive phase lasted for 37 days in Mash 338 while it was shorter in Mash1-1 i.e. 33days (Table 1).

Growth Parameters: Plant height varied significantly with each increment of time. In Mash1-1 plant height increased after 60DAS and reached maxima at 75DAS. Plant height was 2 folds more in Mash1-1 than Mash 338. Plants of Mash338 were dwarf erect and compact with determinate growth habit whereas Mash1-1 plants were tall, spreading with indeterminate growth. Number of primary and secondary branches per plant was more in Mash338 than Mash1-1.Number of leaves per plant increased gradually in both the genotypes and were maximum at 90DAS followed by a decline (Fig. 1). Number of leaves were more in Mash338 but no significant variations were recorded between the two cultivars. Similarly not much differences were noticed for number of nodules within the two varieties however nodulation was maximum at 45DAS.

Dry Matter Accumulation: Dry matter varied significantly in the different plant parts with growth and development of the crop. Dry weight of the leaves was the maximum at 60DAS followed by a decline thereafter. Dry matter assimilation in leaves was almost double in Mash1-1 at 60 DAS. Dry weight was highest at 75DAS in shoot. Dry weight varied significant at 60DAS and was more in Mash1-1.Root dry weight was more in Mash338 at 30 and 45DAS and after that root dry matter increased in the Mash1-1. Dry weight of the nodules was highest at 60DAS (Fig. 2) but the number was highest at 45 DAS. During the earlier stages of growth the allocation of dry matter was towards the vegetative plant parts both above and underground. However after 70days of growth dry matter was more in the shoot from where it was mobilized towards pod filling as indicated by seed weight. These results are in line with the findings of Reddy *et al.* [5] and Dasgupta and Das [6].

Leaf Area and Related Traits: Mash338 registered higher leaf area per plant. Leaf area was highest at 60DAS followed by gradual decline in Mash338 and an abrupt decrease was noticed in Mash1-1 (Fig. 3). Leaf weight ratio (LWR) was highest at 60DAS, leaf area ratio (LAR) and specific leaf area (SLA) at 45 DAS in Mash1-1. Leaf shoot ratio declined with the crop growth and development in Mash338 whereas it was highest at45 DAS in the second variety. Specific leaf weight (SLW) was more at 30DAS in Mash338 and at 75DAS in Mash1-1. However no specific trend was accounted for as reported by

Table 1: Reproductive phase and flower drop in Mashbean genotypes

Genotypes	Initiation of flowering	Cessation of flowering	Flowering duration (Days)	Initiation of podding	Cessation of podding (days)	Podding duration (days)	Flower drop/900cm^2	Days to maturity
Mash338	39.4	75.6	36.1	42.4	76.4	34.0	18.3	90
Mash1-1	51.8	82.9	31.5	54.7	84.5	29.8	11	98
C.D @5%	3.4	1.08		1.31	1.11	NS	2.1	1.89

Table 2: Net assimilation rate (NAR mg/cm^2/15days), Crop growth rate (CGR mg/cm^2/15days) Relative growth rate (RGRmg/mg/15days) at different stages of growth

	NAR			CGR			RGR		
Genotypes	30-45	45-60	60-75	30-45	45-60	60-75	30-45	45-60	60-75
Mash338	1.9	9.26	2.91	1.04	4.99	.948	.278	.515	.130
Mash1-1	5.11	16.38	1.38	1.83	10.68	.826	.827	1.54	.077
C.D @5%	1.22	2.93	0.332	0.457	1.56	.124	.164	0.192	0.057

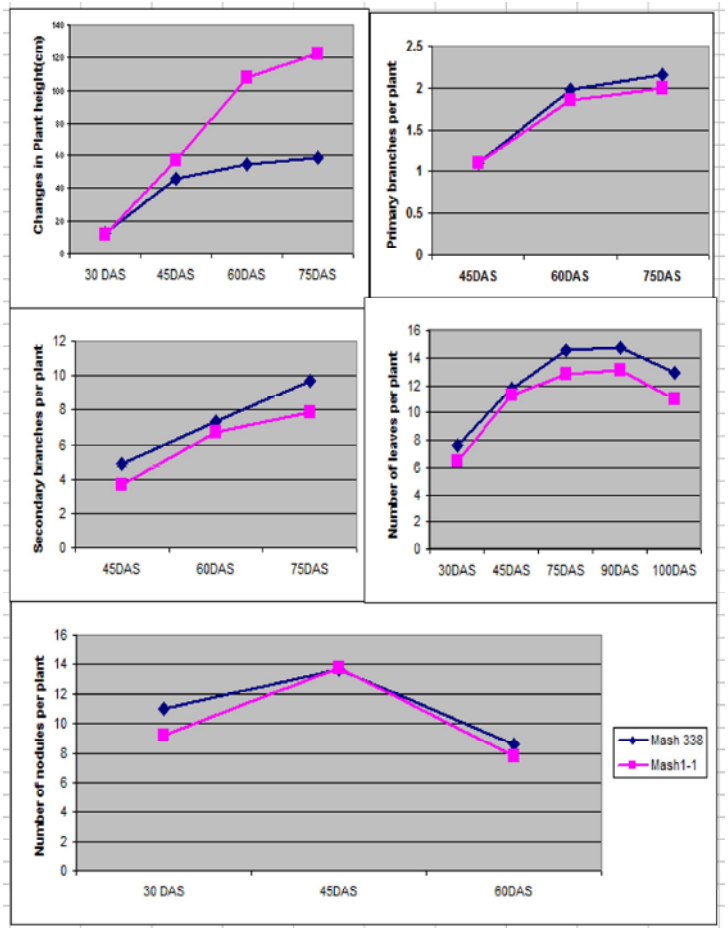

Fig. 1: Growth parameters at different growth and developmental stages in mash bean genotypes.

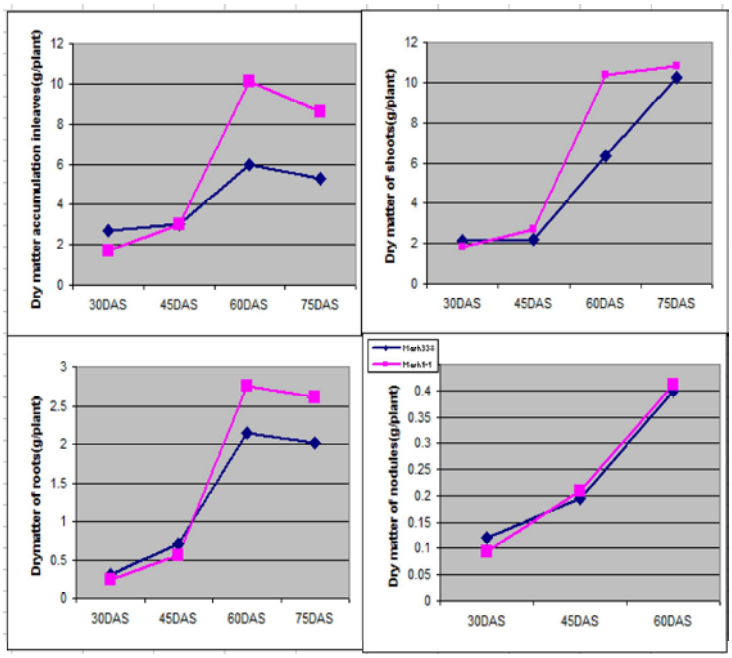

Fig. 2: Partitioning of dry matter in different plant parts at phenological stages of crop growth.

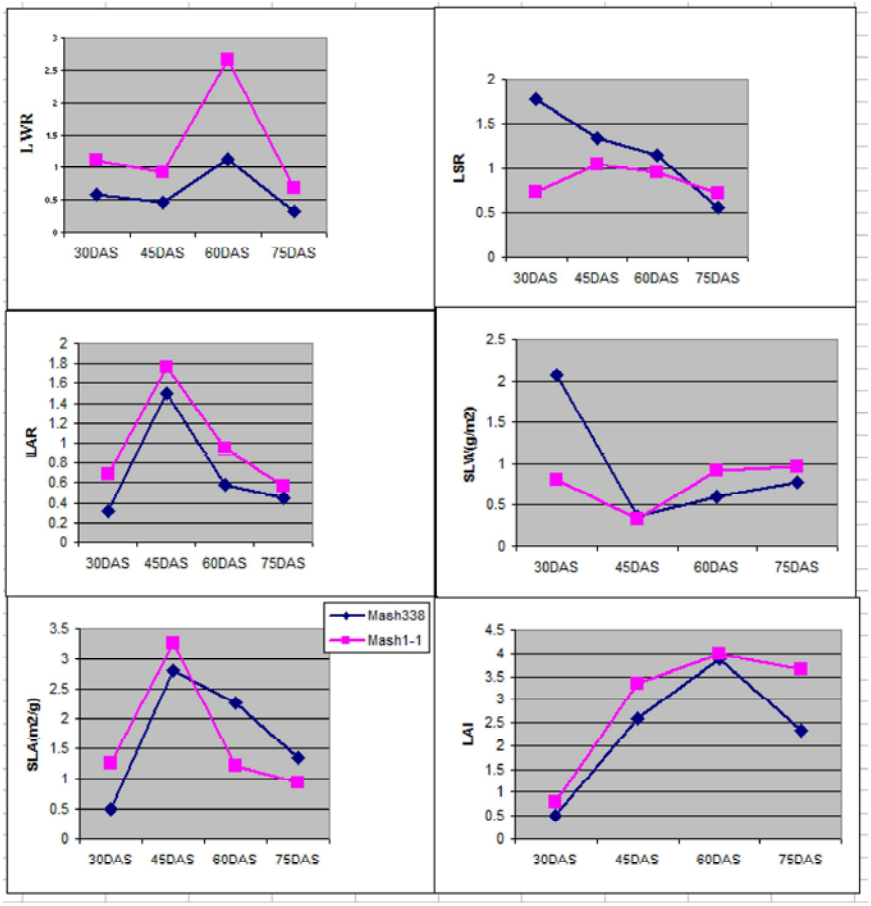

Fig. 3: Leaf traits as influenced by crop growth and development.

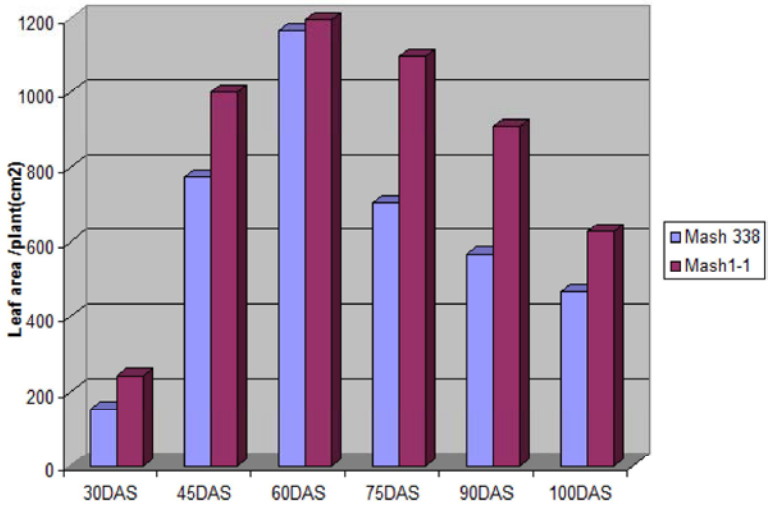

Fig. 4: Changes in leaf area at different stages of crop growth in mash bean genotypes.

Singh and Singh[7].Inverse relation between NAR and SLW has been shown by Gill *et al.* [8]. Leaf area index reached maxima at 60DAS and was almost comparable in both the cultivars (Fig. 4). Most of the pulses have low LAI as reported by Lawn and Troedson [9]. Sekhon *et al.* [10] showed increased leaf area to some extent tends to increase the transfer of photosynthates to the sinks.

Table 3: Changes in the chlorophyll content (mg/g F.W) at different phenological stages in mashbean cultivars

	Days after sowing (DAS)														
	30			45			60			75			90		
Genotypes	Chl.a	Chl.b	Total	Chl.a	Chl.b	Total	Chl.a	Chl.b	Total	Chl.a	Chl.b	Total	Chl.a	Chl.b	Total
Mash338	.707	.541	1.25	1.15	.203	1.35	.844	.382	1.23	.727	.361	1.08	.652	.379	1.03
Mash1-1	.799	.534	1.33	.798	.562	1.36	1.03	.283	1.31	.945	.368	1.31	1.12	.160	1.28
C.D @5%	0.696	0.468	0.110	0.222	0.677	0.257	0.169	0.116	0.176	0.153	0.587	0.201	0.160	0.319	0.189

Table 4: Yield attributes and yield in mashbean genotypes

Genotypes	Pods/plant	Seeds/pod	100-seed weight(g)	Biological yield(Kg/ha)	Grain yield(Kg/ha)	HI(%)
Mash338	26.3	6.8	3.61	6110	1676	27.4
Mash1-1	24.0	6.6	3.84	8313	1204	14.4
C.D @5%	2.6	0.611	2.57	124	188	

Crop Growth Rate: Significant differences were recorded during the growth phases in urdbean.Net assimilation rate was maximum at (45-60) DAS. Similarly crop growth rate (CGR) and relative growth rate (RGR) were highest at 45-60DAS followed by a decline (Table 3). However highly positive significant correlation was registered with yield at 60-75 DAS. Significant genotypic and temporal differences were recorded with respect to NAR, LAR and RGR by Prasad *et al.* [11].

Photosynthetic Pigments: Different component of chlorophyll varied significantly at different stages of growth and development (Table 3). Chlorophyll content was highest at 45 DAS in both the cultivars however it was higher in Mash1-1.Chl a at 45DAS and Chl b at three stages of growth i.e. 30,60 and 90 DAS showed highly significant positive correlation with yield.

Yield and Yield Attributes: Number of pods per plant and seeds per pod were higher in Mash338whereas 100seed weight was more in Mash1-1 (Table 4). Biomass and grain yield varied significantly within the two cultivars. Mash338 was higher yielder (1676kg/ha) with HI of 27.4%indicating efficient partitioning of dry matter as compared to Mash1-1. Higher yield in Mash 338 was due to more leaf area per plant, number of primary and secondary branches, nodules, leaves, number of pods/plant, seeds/pod and efficient partitioning of assimilates. Yield attributes particularly pods/plant and seeds per pod showed highly positive correlation (r=0.999) with yield. These findings are in accordance with the results obtained by other researchers for most of the legumes [12-15].

REFERENCES

1. Sen, S., 1996. Economic Botany, New Central Book Agency (Pvt.) Ltd. Calcutta, India, pp: 42-43.
2. Singh, A., T.S. Bains and P. Sharma, 2011. Exploiting Genetic Variation for some important physiological parameters for development of efficient plant type in mungbean. Proc of the International Conference Preparing Agriculture for Climate change Feb 6-8, Punjab Agricultural University, pp: 425-426.
3. Radford, P.S., 1967. Growth analysis formulae their use and abuse. Crop Sci., 7: 171-173.
4. Hiscox, J.D. and G.F. Israelstam, 1979. A method for the extraction of chlorophyll from leaf tissue without maceration. Can. J. Bot., 57: 1332-1334.
5. Reddy, S.N., B.G. Singh and I.V.S. Rao, 1990. Analysis of dry matter production, growth and yield in black gram varieties. J. Maharashtra Agri. Uni., 15: 184-191.
6. Dasgupta, T. and P.K. Das, 1991. Genetic divergence in black gram. Ind. J. Agri. Res., 25: 7-13.
7. Singh, B.G. and J.N. Singh, 1982. Effect of seasonal changes on the growth parameters of green gram (*Vigna radiata L. Wilczek*). Ind. J. Plant Physiol., 25: 382-389.
8. Gill, D.S., M.M. Verma and G.S. Brar, 1992. Physiological parameters determining yield in mungbean. Crop Improvement, 19: 29-33.
9. Lawn, R.J. and R.J. Traedson, 1990. Pigeon pea: Physiology of yield formation. In The pigeon pea (Ed. Y.L. Nene, S.D. Hall and V.K. Sheila) pp: 179-208 Wallingford, CAS International.

10. Sekhon, H.S., G. Singh and J.S. Brar, 2002a. Effect of population density and planting geometry on the growth and yield of mungbean (*Vigna radiata L. Wilczek*) genotypes. Environ. and Eco., 20: 897-901.
11. Prasad, S. and J.P. Srivastava, 1999. Physiological analysis of yielding ability in mungbean. Ind. J. of Pulses Res., 12: 49-56.
12. Arsad, M.A., A. Bakhsh and A. Ghafoor, 2004. Path co-efficient analysis in chickpea (*Cicer arietinum L.*) under rainfed conditions. Pak. J. Bot., 36(1): 75-81.
13. Siddique, M., M.F.A. Malik and S.I. Awan, 2006. Genetic divergence association and performance evaluation of different genotypes of mungbean (*Vigna radiata* L). Int. J. Agric. and Biol., 8(6): 793-795.
14. Malik, M.F.A., A.S. Qureshi, M. Ashraf and A. Ghafoor, 2006. Genetic variability of the main yield related characters in Soybean. Int. J. Agric and Biol., 8(6): 815-819.
15. Malik, M.F.A., M. Asharf, A.S. Qureshi and A. Ghafoor, 2007. Assessment of genetic variability correlation and path analysis for yield and its components in Soybean. Pak. J. Bot., 39(2): 405-413.