IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN (P): 2347–4580; ISSN (E): 2321–8851
Vol. 2, Issue 7, Jul 2014, 175–186
© Impact Journals

PERFORMANCE OF MUNGBEAN VARIETIES UNDER DIFFERENT DATE OF SOWING IN CHHATTISGARH PLAINS UNDER IN *VERTISOLS* OF CHHATTISGARH PLAINS

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ABSTRACT

The present investigation entitled **"**Performance of mungbean varieties under different date of sowing in Chhattisgarh plains under in Vertisols of Chhattisgarh plains**"** was carried out at Instructional Farm, IGAU, Raipur during kharif season of 2004. The soil of the experimental field was clayey in texture (Vertisols) locally known as "Bharri". The soil was neutral in pH and had low nitrogen and medium phosphorus and high in potassium content. The experiment was laid out in split plot design with three replications. The treatments consisted of four dates of sowing viz. 10th July (D_1), 25th July (D_2), 09 August (D_3) and 24th August (D_4) as main-plot treatment and twelve varieties viz., V_1 : TM-99-2, V_2 : Malviya Jyoti, V_3 : ML-5, V_4 : RM-03-71, V_5 : Pragya, V_6 : RM-06-08, V_7 : BM-4, V_8 : TM-2002-4, V_9 : ML-31, V_{10} : Pusa Vishal, V_{11} : TM-2000-1 and V_{12} : HUM-12 as sub-plot treatment.

Results revealed that yield attributes viz. pods plant^{-1}, seeds pod^{-1}, seeds plant^{-1} and test weight were the highest under earliest date of sowing i.e. 10th July which ultimately gave the highest yield. Though, a slight reduction in yield was observed till 25th July sowing but drastic reduction in yield occurred if the sowing is delayed further.

Variety BM-4 was found to be best yielder (472 kg ha^{-1}) closely followed by HUM-12 (469 kg ha^{-1}). Though, they had a lower test weight than Pragya, Malviya Jyoti and ML-5. Their more number of pods, more number of seeds plant^{-1} and more number of seeds pod^{-1} have attributed for their supremacy over other varieties. Interaction between variety BM-4 and 10th July sowing outyielded amongst the other treatment combinations.

KEYWORDS: Mungbean Varieties, Yield Performance, Vertisols

INTRODUCTION

In agriculture point of view, Chhattisgarh state is divided into three sub agroclimatic region, i.e. Chhattisgarh plains, Bastar plateau and Northern hill zone with four type of soils, *Bhata* (*Entisols*), *Matasi* (*Inceptisols*) 45.5 per cent, *Dorsa* (*Alfisols*) 10.0 per cent and *Kanhar* (*Vertisols*) 25.0 per cent of the total net cultivated area. In Chhattisgarh, during *kharif* season farmer prefer to grow mungbean in unbunded heavy soil locally known as *Bharri* land. Presently, rice, soybean and pulses occupies 10 per cent (3.4 lakh ha) area under this situation

Mungbean, is the important crop of Chhattisgarh. It occupies an area of 0.29 lakh ha with the production and productivity of 0.12 lakh tonnes and 425 kg ha^{-1}, respectively. The major districts growing mungbean in Chhattisgarh are Mahasamund (15.8% area), Durg (12.7%), Dantewara (11.7%), Kanker (11.1%) and Rajnandgaon (10.3%).

Mungbean (*Vigna radiata* L. Wilczek) is an important pulse crop of Indian Agriculture. It is warm weather crop and cultivated in rainy, winter and summer season in various parts of the country. The total area under pulse crop in our

country is 23.19 m ha with the productivity of 623 kg ha^{-1}. Out of this, the mungbean occupies an area of 2.75 m ha. The production of this crop is 0.98 mt with the productivity of 356 kg ha^{-1}. The major mungbean growing states are Orissa, Maharashtra, Andhra Pradesh, Rajasthan, Karnataka, Gujarat, TamilNadu, Madhya Pradesh, Uttar Pradesh and Punjab. Orissa ranks first in area and production and Punjab is the leading state in productivity (Anonymous, 2004).

In *kharif* season it is very important to sow crop in proper time for obtaining optimum production and leaving enough time for planting of *rabi* crops in this agroclimatic zone of Chhattisgarh. Sowing time is one of the most important factor for realising higher yield as it affects the duration of vegetative, reproductive and maturity period of the crop. Besides yield and other attributing characters, sowing time play an important role in nitrogen fixation (Siag and Gaur, 1995). More yield can be obtained in early sowing dates due to longer growth period available (Anonymous, 1981). Identification of suitable varieties and optimum date of sowing is very important for high yields (Lal, 1985). The optimum time is mainly dependent on prevailing agroclimatic condition of an area besides the variety grown. Sowing during the optimum period, therefore, ensures better harmony between the plant and weather which ultimately results in high crop yields (Venkateswarlu and Soudara Rajan, 1991).

REVIEW OF LITERATURE

Effect of Dates of Sowing

Growth Parameters, Nodulation and Phenology

Chaudhary *et al.* (1988) reported that maximum dry matter accumulation in different plant parts was recorded in 6 July planting. Delay in planting led to significant reduction in dry matter accumulation. The reduction in dry matter accumulation was more pronounced when planting was delayed beyond 20 July.

Gupta and Lal (1989) observed that the sowing dates markedly affected the plant height and number of branches $plant^{-1}$. Delayed sowing condition increased plant height and branches $plant^{-1}$ when sown on 30 March. All other treatment resulted in significantly lower plant height and number of branches. All other treatment (1, 10, 20 March and 9 April) resulted in significantly lower plant height and number of branches in blackgram. Chouatia *et al.* (1993) reported that the crop sown on 15 February and 2 March recorded significantly more plant height, dry matter $plant^{-1}$, nodules $plant^{-1}$, leaf area index, branches $plant^{-1}$, pods $plant^{-1}$, pod length, grains pod^{-1}, 1000-seed weight, grain yield $plant^{-1}$ and consequently higher grain and stover yields compared with that sown on 31 January and 17 March.

Ram and Dixit (2001) found that growth parameters viz. plant height, branches $plant^{-1}$, leaves $plant^{-1}$ and dry matter accumulation were influenced significantly by dates of sowing. Sowing of mungbean earlier gave the significantly higher values of all the growth parameters as compared to sowing on March 20. Singh and Singh (2000) found that the July 24 sowing recorded significantly higher number of trifoliate leaves and more accumulation of total dry matter per plant and its partitioning to different plant parts viz. stem leaf and reproductive parts than that of August 29 sowing at all the stages of growth.

Soomrao and Khan (2003) reported that besides number of pods $plant^{-1}$, pod growth was also significantly affected by time of sowing. Pod length decreased when sowing was delayed. Earlier sowing (5^{th} July) produced maximum (9.2 cm) pod length, followed by 15^{th} July sown crop having pod length of 8.5 cm. Least pod length of 5.1 cm was observed in last sowing date (5^{th} August).

Yield Attributes and Yield

Urd crop, sown on 28th June (the 1st date of sowing) recorded maximum grain yield than the other later dates of sowing. But, in another experiment 15th July, 30th July and 14th August sowing were found significantly superior to 1st July sowing (Anonymous 1984). No difference was observed among 15th July, 30th July and 14th August sowing. Singh *et al.* (1985) reported that the seed yield of mungbean was affected significantly due to different date of sowing. They also noted the maximum seed yield (13.35 and 13.05 q ha^{-1}) with early sowings (1st and 15th March) which was reduced by 16.85 and 34.09 per cent when crop was shown on 30th March and 15th April, respectively in comparison to 15th March.

Chaudhary *et al.* (1988) stated that the early planting in first weak of July results in higher yield and any delay in sowing beyond this date causes reduction in yield of blackgram. Sharma *et al.* (1988) reported that the grain yield was significantly affected due to sowing dates. The highest grain yield was recorded with early date of sowing (13th July). The increases in grain yield was 917.0, 525.0 and 310.9 per cent in 1986 and 314.4, 247.4 and 209.3 per cent in 1987 with 13th, 23rd July and 2nd August over last date of sowing (12th August). Saharia (1988) noted that the late sowing are unfavourable due to low temperatures in the winter season.

Singh and Yadav (1989) found that sowing dates significantly influenced the yield and yield attributes. Maximum grain and straw yields were obtained in 10 November sowing. The increases being 47.7 and 23.7 per cent over 10 October and 25 October sowings, respectively. Number of pods $plant^{-1}$, grains pod^{-1}, 1000 grain weight and grain yield $plant^{-1}$ are were superior in 10 November sowing which was responsible for higher grain yield in this date in dwarf field peas. Gupta and Lal (1989) reported that the sowing dates markedly affected the grain in both the years 1985-86. The crop sown on 10 March being similar to 1 and 20 March sowing and recorded significantly higher grain yield as compared with 30 March and 9 April sowing of blackgram.

Jeswani and Baldev (1990) reported that the despite the slight variation in optimum date of sowing during different seasons depending on agro-climatic zone, variety and soil condition, sowing between mid-June to mid-July is found to be optimum time for *kharif* season blackgram crop. Saini and Jaiswal (1991) reported that sowing on 15 March being at per with sowing on 1 March, gave the highest grain yield (13.75 q ha^{-1}). Further, delay in sowing drastically reduced the yield.

Padhi and Sahoo (1991) studied the response of greengram varieties to 5 dates of sowing (1,15, 30 March and 15 and 30 April) and reported that optimum time of sowing of greengram was found to be mid March and delay or advancement in sowing date reduced the grain yield significantly. Plants in 30 March sowing were the tallest. The highest number of seeds pod^{-1} and seed weight was obtained in 15 March sowing. Singh and Singh (1991) obtained the highest grain yield when the crop was shown on 31 May during both the years 1984-85. Delay in sowing beyond 31 May resulted in gradual decrease in grain yield. The maximum values of all yield attributes were recorded when the crop was sown on 31 May. Singh *et al.* (1993) reported that the time of sowing is more common in northern and eastern parts of the country. Mungbean gives the highest grain yield in early sowing than delayed sowing. Tomar *et al.* (1993) reported the highest yield when crop was sown on 5 March sowing at Morena (Madhya Pradesh).

Siag and Gaur (1995) reported that sowing time significantly influenced grain yield of mungbean. Crop planted on July 15 gave a maximum yield of 1251 kg ha^{-1} as against the crop planted on August 5 with an average yield of only 616 kg ha^{-1}. Further, number of pods $plant^{-1}$ and test weight was also higher in July 15 sown crop. The second best date of

planting was July 5 which recorded a yield of 1045 kg ha^{-1}. Dhanjal *et al.* (2000) observed the highest grain yield of crop when sown on 15 March. Further, significantly more number of pods plant^{-1}, grains pod^{-1} and 1000 grain weight were recorded in this date of sowing than the crop sown on 31 March and 16 April.

Ram and Dixit (2001) observed that sowing of greengram on March 30 produced significantly higher grain yield (10.15 q ha^{-1}) which was 7.09 and 15.17 per cent higher when compared to sowing on April and March 20. Similarly dates of sowing showed significant influence on yield attributing parameters viz. pods plant^{-1} and grains pod^{-1}. Panwar and Sharma (2004) tested four planting dates (25 February, 11, 26 March, 10 April) and found that grain yield ha^{-1} increased with delay in planting upto March 11, thereafter, it declined significantly and drastic reduction took place beyond March 26.

MATERIALS AND METHODS

Number of pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1}

The individual plot wise counting from the five marked plants was done for number of pods plant^{-1}, number of seeds pod^{-1} and number of seeds plant^{-1} at the time of harvesting and then average figures were worked out.

100-Seed Weight (g)

Random seed samples were taken from the produce of each net plot separately after recording the weight and collected seed samples were dried in an oven at 60°C till the weight became constant. Hundred seeds were counted from the oven dried samples of each plot and then weight was recorded on an electronic balance.

Seed Yield (kg ha^{-1})

The crop of each net plot was separately threshed, winnowed and the seed yield was corrected at 14 per cent moisture content. The seed yield was then converted into kg ha^{-1}.

RESULTS

Number of Pods Plant^{-1}

The data on number of pods plant^{-1} under different main and sub treatments have been presented in Table 1 and 2. As regards to dates of sowing, 10th July gave the maximum average number of pods plant^{-1} (35.22). Under other dates of sowing number of pods plant^{-1} reduced significantly as the sowing date was extended. It is clear from the table that there was significant difference in number of pods plant^{-1} under dates of sowing. Earlier date of sowing gave maximum number of pods plant^{-1}. It may be due to higher number of primary and secondary branches plant^{-1} and number of flowers plant^{-1} with adequate supply of soil-moisture. Similar observations have also been reported by Tiwari and Ram (1985), Chaudhary *et al.* (1988), Gupta and Lal (1989), Singh and Singh (2000) and Soomrao and Khan (2003).

Under different sub-treatments, the varieties showed significant difference. Variety BM-4 being at par with HUM-12 and gave significantly more number of pods plant^{-1} than others. The lowest number of pods plant^{-1} was recorded under variety Pragya. All the variety under test differed significantly. Variety BM-4 being at par with HUM-12 due to genetical characters. Similar observations have been recorded by Tiwari and Ram (1985), Chaudhary *et al.* (1988), Gupta and Lal (1989), Singh and Singh (2000) and Soomrao and Khan (2003).

Interaction between dates of sowing and varieties were found to be significant. Sowing of mungbean variety BM-4 on 10th July resulted significantly the maximum number of pods plant^{-1} (41.93) which remained at par to variety HUM-12 sown on 10th July. Similar observations have been reported by Tiwari and Ram (1985), Uprit (1985), Chaudhary *et al.* (1988) and Soomrao and Khan (2003).

Table 1: Number of Pods at Different Duration of Mungbean as Affected By Dates of Sowing and Varieties

Treatment	Pods plant^{-1}, No.		
	45 DAS	55 DAS	65 DAS
Dates of Sowing			
D_1 : 10th July	4.01	28.22	2.88
D_2 : 25th July	4.94	25.08	2.78
D_3 : 09th August	5.70	19.7	1.82
D_4 : 24th August	5.75	12.41	1.72
SEm±	**0.049**	**0.262**	**0.021**
CD (P=0.05)	**0.170**	**0.902**	**0.073**
Varieties			
V_1 : TM-99-2	5.40	23.49	2.32
V_2 : Malviya Jyoti	4.68	20.25	2.07
V_3 : ML-5	4.82	20.02	1.97
V_4 : RM-03-07	5.68	25.40	2.95
V_5 : Pragya	3.77	13.78	1.57
V_6 : RM-06-08	5.14	22.20	2.30
V_7 : BM-4	5.75	25.17	3.03
V_8 : TM-2002-4	5.05	17.45	1.83
V_9 : ML-131	4.67	20.41	2.17
V_{10} : Pusa Vishal	5.50	24.38	2.63
V_{11} : TM-2000-1	4.86	16.12	1.67
V_{12} : HUM-12	5.92	27.55	3.07
SEm±	**0.092**	**0.460**	**0.035**
CD (P=0.05)	**0.257**	**1.287**	**0.099**

Table 2: Number of Pods Plant^{-1} as Affected by Interaction Between Dates of Sowing and Varieties of Mungbean

Treatment	Pods plant^{-1}, No.				
Dates of sowing / Varieties	10th July (D_1)	25th July (D_2)	09th Aug. (D_3)	24th Aug. (D_4)	Mean of varieties
V_1 : TM-99-2	37.73	35.66	29.53	22.26	**31.30**
V_2 : Malviya Jyoti	33.40	31.33	24.53	17.56	**26.70**
V_3 : ML-5	33.60	31.13	24.63	17.66	**26.77**
V_4 : RM-03-07	40.80	38.13	32.40	25.06	**34.10**
V_5 : Pragya	24.40	21.93	16.53	13.66	**19.13**
V_6 : RM-06-08	36.43	34.86	28.46	20.86	**30.15**
V_7 : BM-4	41.93	40.40	34.33	26.00	**35.66**
V_8 : TM-2002-4	30.26	28.00	23.00	16.83	**24.52**
V_9 : ML-131	34.20	32.33	25.26	17.73	**27.38**
V_{10} : Pusa Vishal	39.86	36.73	30.40	23.33	**32.58**
V_{11} : TM-2000-1	28.86	26.66	20.46	14.80	**22.70**
V_{12} : HUM-12	41.13	38.60	32.60	29.66	**35.48**
Mean of dates of sowing	**35.22**	**32.98**	**26.84**	**20.45**	

		SEm±	CD (P=0.05)
Dates of sowing		0.102	0.353
Varieties		0.137	0.384
For comparing dates of sowing mean at the same level of variety		0.275	0.769
For comparing variety mean at the same level of dates of sowing		0.283	0.814

Number of Seeds Pod^{-1}

The data on number of seeds pod^{-1} under different main and sub-treatments have been presented in Table 3. As regards to dates of sowing, 10th July gave the highest number of seeds pods^{-1} (7.77) though it was at par to 25th July (7.37) and both were significantly superior to 09th August and 24th August sowing. The last date of sowing 24th August gave the lowest number of seeds pod^{-1}. Crop enjoyed on an average 72 days under earliest sowing. The crop duration for later sowing dates shrinked gradually as the sowing was delayed. Appearance of more number of seeds pod^{-1} have been due to relatively longer crop duration within it more number of days for reproductive phase in earliest sowing date as compared to other sowing dates. It may be concluded from the experiments that the earliest sowing of mungbean gave the higher number of seeds pod^{-1}. Similar results have been also reported by Tiwari and Ram (1985), Chaudhary *et al.* (1988), Gupta and Lal (1989), Singh and Singh (2000), Soomrao and Khan (2003) and Kumar and Singh (2003).

Varieties were also found to be differing significantly. Variety BM-4 gave the highest number of seeds pod^{-1} (8.12) which was found to be at par with HUM-12 (7.87). Both the above mentioned varieties were significantly superior to rest ten varieties. Variety Pragya gave significantly the lowest seeds pod^{-1}(5.63). Similar results were also noted by Tiwari and Ram (1985), Chaudhary *et al.* (1988), Gupta and Lal (1989), Singh and Singh (2000), Soomrao and Khan (2003) and Kumar and Singh (2003).

Interaction between dates of sowing and varieties were also found to be significant. Sowing mungbean variety BM-4 on 10th July resulted in significantly the highest seeds pod^{-1} (9.60) which was at par with the variety HUM-12 sown on 10th July (9.33). The variety ML-5 gave significantly the lowest seeds pod^{-1} (3.80) sown on 24th August. Similar results were reported by Padhi and Sahoo (1991) and Soomrao and Khan (2003).

Table 3: Number of Seeds Pod^{-1} as Affected by Interaction Between Dates of Sowing and Varieties of Mungbean

Treatment	Seeds pod^{-1}, No.				
Dates of sowing / Varieties	10th July (D_1)	25th July (D_2)	09th Aug. (D_3)	24th Aug. (D_4)	Mean of varieties
V_1 : TM-99-2	8.00	7.93	5.20	4.40	**6.38**
V_2 : Malviya Jyoti	6.93	6.80	5.00	4.27	**5.75**
V_3 : ML-5	6.93	6.67	6.33	3.80	**5.93**
V_4 : RM-03-07	8.33	7.53	6.87	5.40	**7.03**
V_5 : Pragya	6.20	5.93	6.40	4.00	**5.63**
V_6 : RM-06-08	8.53	7.87	5.87	5.40	**6.92**
V_7 : BM-4	9.60	8.80	7.67	6.40	**8.12**
V_8 : TM-2002-4	7.47	7.27	5.93	4.00	**6.17**
V_9 : ML-131	7.07	6.80	5.33	4.20	**5.85**
V_{10} : Pusa Vishal	7.80	7.47	5.07	4.53	**6.22**
V_{11} : TM-2000-1	7.07	6.73	5.27	4.00	**5.77**
V_{12} : HUM-12	9.33	8.67	7.00	6.67	**7.87**
Mean of dates of sowing	**7.77**	**7.37**	**5.99**	**4.74**	

	SEm±	CD (P=0.05)
Dates of sowing	0.120	0.41
Varieties	0.127	0.35
For comparing dates of sowing mean at the same level of variety	0.262	0.73
For comparing variety mean at the same level of dates of sowing	0.276	0.80

Number of Seeds Plant^{-1}

The number of seeds plant^{-1} is an important attributes which may be expected to have a bearing on yield obtained due to different treatments under study. The data on number of seeds plant^{-1} under different main and sub-treatments have been given in Table 4. As regards to dates of sowing, all the four dates under study resulted in having significant difference in number of seeds plant^{-1}. The maximum number of seed plant^{-1} (278.23) was obtained in 10th July sowing which was the significantly superior to rest three dates. Significantly the lowest number of seeds plant^{-1} (99.00) was obtained with 24th August sowing.

Crop enjoyed on an average 72 days under earliest sowing. The crop duration for later sowing date reduced the number of seeds pod^{-1} and number of seeds plant^{-1}. It has been concluded from the experiment that the earliest sowing of mungbean gave the maximum number of seeds plant^{-1}. Similar results were also noted by Tiwari and Ram (1985), Singh and Singh (2000), Soomrao and Khan (2003) and Kumar and Singh (2003).

Variety BM-4 produced significantly the highest number of seeds plant^{-1} (285.85) which was at par with HUM-12 (279.20). Both the above mentioned varieties were significantly superior to rest ten varieties. Variety Pragya (112.10) gave significantly the lowest number of seeds plant^{-1}.It is obvious that all the varieties under test differed significantly with respect to number of seeds plant^{-1}. Similar observations were noted by Tiwari and Ram (1985), Singh and Singh (2000) and Soomrao and Khan (2003).

Interaction between dates of sowing and varieties were also found to be significant. Sowing of mungbean variety BM-4 on 10th July resulted significantly the highest number of seeds plant^{-1} (394.91) which remained at par to variety HUM-12 sown on 10th July (391.55). Similar results were also studied by Siag and Gaur (1995) and Soomrao and Khan (2003).

Table 4: Number of Seeds Plant^{-1} as Affected by Interaction Between Dates of Sowing and Varieties of Mungbean

Treatment	Seeds plant^{-1}, No.				
Dates of sowing / Varieties	10th July (D_1)	25th July (D_2)	09th Aug. (D_3)	24th Aug. (D_4)	Mean of varieties
V_1 : TM-99-2	301.81	282.99	153.57	97.99	**209.09**
V_2 : Malviya Jyoti	231.85	213.01	122.73	75.09	**160.67**
V_3 : ML-5	233.45	207.68	156.03	67.43	**166.15**
V_4 : RM-03-07	340.00	287.33	222.52	135.31	**246.29**
V_5 : Pragya	151.36	130.17	105.48	61.40	**112.10**
V_6 : RM-06-08	311.11	255.88	167.03	112.73	**211.69**
V_7 : BM-4	394.91	340.51	249.99	158.08	**285.85**
V_8 : TM-2002-4	226.04	203.52	136.44	67.79	**158.45**
V_9 : ML-131	241.64	219.92	134.72	79.03	**168.83**
V_{10} : Pusa Vishal	311.04	273.80	154.16	105.76	**211.19**
V_{11} : TM-2000-1	204.04	179.61	107.49	59.20	**137.59**
V_{12} : HUM-12	391.55	316.80	240.32	168.15	**279.20**
Mean of dates of sowing	**278.23**	**242.60**	**162.54**	**99.00**	

		SEm±	CD (P=0.05)
Dates of sowing		4.53	15.59
Varieties		4.12	11.52
For comparing dates of sowing mean at the same level of variety		8.25	23.04
For comparing variety mean at the same level of dates of sowing		9.11	26.90

Test Weight (100 Seed Weight)

The weight of hundred seeds is also an important attribute to yield and effect of under different treatments on seed weight is presented in Table 5.

The data very clearly reveal that date of sowing had a significant effect. The highest test weight (3.09 g) was obtained with 10th July sowing, which was significantly superior to 9th August and 24th August sowing, but remained at par to 25th July sowing. The lowest test weight (2.75 g) was noted under 24th August sowing.

Observation on test weight also indicated the superiority of earliest sowing date significantly followed by 25th July and 9th August and 24th August sown crop produced lightest seeds. It is interesting to note that crop sown in the later dates came to maturity earlier than the earlier sowing because of relatively less growth and biomass production. This might be the reasons for significant differences in 100-seed weight. Similar observations have been reported by Chaudhary *et al.* (1988), Singh and Singh (2000), Pramanik *et al.* (2002), Soomrao and Khan (2003) and Panwar and Sharma (2004).

Variety Pusa Vishal produced significantly maximum test weight (3.48). While the lowest test weight was obtained under variety Malviya Jyoti (2.31). Although, variety Pusa Vishal gave the highest test weight, but could not give the highest seed yield. Varietal differences for test weight have been reported by Chaudhary *et al.* (1988), Anbalagan (1996), Singh and Singh (2000), Pramanik *et al.* (2002), Soomrao and Khan (2003) and Panwar and Sharma (2004).

Interaction between dates of sowing and varieties were also found to be significant. Sowing of mungbean variety Pusa Vishal on 10th July resulted significantly the highest test weight (3.77 g) than other treatment combinations, through it was at par to Pusa Vishal sown on 9th August. The lowest test weight (2.03 g) was noted under variety Malviya Jyoti sown on 24th August.

Table 5: Hundred Seed Weight of Mungbean as Affected by Interaction Between Dates of Sowing and Varieties

Treatment	Hundred seed weight, g				
Dates of sowing / Varieties	10th July (D_1)	25th July (D_2)	09th Aug. (D_3)	24th Aug. (D_4)	Mean of varieties
V_1 : TM-99-2	3.17	3.17	3.03	2.73	**3.02**
V_2 : Malviya Jyoti	2.53	2.40	2.27	2.03	**2.31**
V_3 : ML-5	2.97	2.77	2.83	2.67	**2.81**
V_4 : RM-03-07	3.10	3.10	2.87	2.97	**3.01**
V_5 : Pragya	2.77	2.50	2.33	2.27	**2.47**
V_6 : RM-06-08	3.13	3.10	2.93	2.83	**3.00**
V_7 : BM-4	3.10	3.00	3.00	2.87	**2.99**
V_8 : TM-2002-4	3.27	2.87	3.03	3.07	**3.05**
V_9 : ML-131	3.00	2.93	2.87	2.70	**2.88**
V_{10} : Pusa Vishal	3.77	3.30	3.58	3.30	**3.48**
V_{11} : TM-2000-1	3.40	3.23	3.13	3.03	**3.20**
V_{12} : HUM-12	2.93	2.93	2.83	2.57	**2.82**
Mean of dates of sowing	**3.09**	**2.94**	**2.89**	**2.75**	

	SEm±	CD (P=0.05)
Dates of sowing	0.042	0.146
Varieties	0.049	0.138
For comparing dates of sowing mean at the same level of variety	0.085	0.257
For comparing variety mean at the same level of dates of sowing	0.099	0.288

Seed yield (kg ha^{-1})

The data of yield per plant have been converted into kg ha^{-1} and presented in Table 6. It may be clearly observed from the data that the difference in yield as affected by dates of sowing, varieties and their interaction was found to be significant.

Maximum mean seed yield (506 kg ha^{-1}) was obtained with 10th July sowing which was significantly superior to rest three dates. The lowest seed yield (145kg^{-1}) was noted with 24th August sowing. All the sowing dates differed significantly from each other and the order of their descendance for seed yield was 10th July > 25th July > 9th August and 24th August. It has been concluded from various experiments that the earliest sowing of mungbean gave the highest yield. The seed yield is the resultant of growth and yield attributing characters of a crop. The superiority of growth characters plant height, braches, LAI, dry matter accumulation and nodulation pattern and yield attributes such as pods plant^{-1}, seeds pod^{-1},100 seed weight and podding behaviour as discussed earlier may be the possible reasons for the production of higher yield under 10th July sowing. Similar observations have been reported by Tiwari and Ram (1985), Sharma *et al.* (1988), Chaudhary *et al.* (1988), Jeswani and Baldev (1990), Siag and Gaur (1995), Soomrao and Khan (2003) and Kumar and Singh (2003).

Variety BM-4 produced significantly maximum yield (472 kg ha^{-1}) which was at par with HUM-12 (469 kg ha^{-1}). Both the above mentioned varieties were significantly superior to rest ten varieties. It may due to higher growth and yield attributing characters in these varieties. Varieties Pragya gave significantly the lowest yield (229 kg ha^{-1}). Poor growth of this variety has resulted in reduced yield. Varietal difference for seed yield have been also reported by Tiwari and Ram (1985), Sharma *et al.* (1988), Chaudhary *et al.* (1988), Jeswani and Baldev (1990), Siag and Gaur (1995), Soomrao and Khan (2003) and Kumar and Singh (2003).

Interaction between dates of sowing and varieties were also found to be significant. Sowing of mungbean variety BM-4 on 10th July resulted significantly the highest seed yield (736 kg ha^{-1}) which remained at par to variety RM-03-07 sown on 10th July. Similar observations have been reported by Padhi and Sahoo (1991), Siag and Gaur (1995) and Soomrao and Khan (2003).

Table 6: Seed yield (kg ha-1) of Mungbean as Affected by Interaction between Dates of Sowing and Varieties

Treatment	Seed yield, kg ha-1				
Dates of sowing / Varieties	10th July (D1)	25th July (D2)	09th Aug. (D3)	24th Aug. (D4)	Mean of varieties
V1: TM-99-2	525	512	265	156	365
V2: Malviya Jyoti	360	335	318	191	301
V3: ML-5	415	321	247	170	288
V4: RM-03-07	712	555	342	132	435
V5: Pragya	330	245	236	105	229
V6: RM-06-08	690	572	292	118	418
V7: BM-4	736	568	382	203	472
V8: TM-2002-4	366	342	221	121	263
V9: ML-131	380	346	227	107	265
V10: Pusa Vishal	515	417	205	109	312
V11: TM-2000-1	356	362	195	117	258
V12: HUM-12	684	613	368	212	469

Table 6: Contd.,

Mean of dates of sowing	506	432	275	145	
			SEm±		CD (P=0.05)
Dates of sowing			4.04		13.93
Varieties			4.96		13.86
For comparing dates of sowing mean at the same level of variety			9.93		27.73
For comparing variety mean at the same level of dates of sowing			10.34		29.89

CONCLUSION

All the twelve varieties *viz.*, TM-99-2, Malviya Jyoti, ML-5, RM-03-71, Pragya, RM-06-08, BM-4, TM-2002-4, ML-131, Pusa Vishal, TM- 2000-1 and HUM-12 reached to 50 % flowering almost after the same period, but, if the sowing was extended, less time was required for 50% flowering. All the twelve varieties sown in the first days of sowing took longer period for maturity i.e. 72 days than the other dates of sowing. Thus, days to maturity have decreased with delay in sowing.

Number of pods plant^{-1} was found to be significantly affected due to dates of sowing, varieties and their interaction. Earliest sown crop (10th July) produced the maximum number of pods plant^{-1} which was significantly reduced as sowing was delayed. Varieties HUM-12 and BM-4 recorded significantly higher number of pods plant $^{-1}$ than others. Whereas, variety BM-4 or HUM-12 resulted in significantly higher number of pods plant^{-1} when sown on 10th July as compared to other treatment combinations. Number of seeds pod^{-1} and seeds plant^{-1} also followed the similar trend.

As regards to test weight, significant differences were found among varieties, dates of sowing and interaction between dates of sowing and varieties. The highest test weight was noticed under 10th July sowing; though it remained statistically similar to 25th July sowing. The maximum test weight was recorded with variety Pusa Vishal. Sowing of mungbean variety Pusa Vishal on 10th July gave significantly the highest test weight. However, it was at par to variety Pusa Vishal sown on 9th August sowing.

The dates of sowing and varieties had a significant effect on yield ha^{-1}. The effect of dates of sowing was more pronounced and highest yield (506 kg ha^{-1}) was obtained under first date of sowing i.e. 10th July. The yield however, progressively and significantly decreased upto 09th August. Variety BM-4 gave the highest seed yield (475 kg ha^{-1}) which was followed by HUM-12. The interaction between dates of sowing and varieties was also found to be significant in affecting seed yield ha^{-1}. Significantly maximum seed yield ha^{-1} was in general, obtained in combination of first date of sowing 10th July with variety BM-4 or RM-03-07.

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