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RESEARCH PAPER

Nodulation, yield and thermal requirement of mungbean (*Vigna radiata* L.) genotypes as influenced by date of sowing

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Abstract : A field experiment was carried out during *Kharif* season 2011 with the objective to study the impact of date of sowing on nodulation, thermal requirement and yield of mungbean genotypes (BM-4, RM-03-71, RM-03-79, ML-131, Pusa 1072 and COGG 973). Early sowing(July 20) resulted in absorbing sufficient amount of heat units in less time as compared to late sowings (Aug. 9) which acquired more days to mature and resulted in accumulation of more growing degree days (GDD) as compared to early date of sowing. There was a drastic reduction in yield in case of August 9 sowing compared to July 30 and July 20 sowing date. Genotypes, RM-03-79 produced significantly higher yield than other genotypes except COGG 973 in different date of sowing.

Key Words : Mungbean, Nodulation, Thermal indices

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INTRODUCTION

Mungbean (*Vigna radiata* L.) is an important pulse crop of *Kharif* season in India. The crop is highly sensitive to environment. Therefore, time of sowing shows remarkable influence on the growth and productivity of mungbean in *Kharif* due to rainy season (Brar *et al.*, 1988*)*. The optimum time of sowing ensures the complete harmony between the vegetative and reproductive phases on one hand and the climatic rhythm on the other and helps in realizing the potential yield (Singh and Dhingra, 1993). Temperature is the prime weather variable which affects plant life. Heat unit concept is the agronomic application of temperature effect on plant, which has been employed to correlate phenological development in crop and to predict maturity dates (Nuttonson, 1955*;* Major *et al.*, 1975). Therefore, an experiment was planned and conducted on different dates of sowing of mungbean genotypes, so that these indices can be used as tools for characterizing thermal responses in different cultivars of mungbean. Supporting findings were made by Sehrawat *et al.* (2013); Mathur *et al.* (2007) and Payasi *et al.* (2010).

MATERIAL AND METHODS

The experiment was conducted at Research Cum Instruction Farm of the Indira Gandhi Krishi Vishwavidalaya, Raipur (21°16' N latitude and 81°36' E, 298 m) during *Kharif* season of 2011. The soil of the experimental field was *Vertisols* in texture having pH 6.9. Fertility status of soil was categorized as low, medium and high in available nitrogen (225.40 kg ha^{-1}), phosphorus (14 kg ha^{-1}) and potassium (360.80 kg ha^{1}), respectively. The experiment was laid in Split Plot Design with three replications. The main plot treatments comprised of three date of sowing (July 20, July 30 and August 9) and six

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genotypes (BM-4, RM-03-71, RM-03-79, ML-131, Pusa-1072 and COGG-973) were allocated to subplots. Recommended dose of @ 20-16-20-20 kg NPKS ha^{-1}, fertilizer were applied through urea, single super phosphate, murate of potash and gypsum, respectively. The 2% foliar spray of urea was also applied at pre flowering and 10 days after 1st spray. Weeds were controlled by two hand weeding at 20 and 40 days after sowing (DAS). The total 1100.2 mm rainfall was received during crop growth period. The accumulated growing degree days (GDD) for each day were calculated for different phenological event as per the equation suggested by Nuttonson (1955), using base temperature of 10^{0}C. Heliothermal units (HTU) are the product of growing degree days (GDD) and corresponding actual sunshine hours for that day. Photothermal units (PTU) are the product of growing degree days and corresponding day length hours for that day. GDD, HTU and PTU were calculated from the date of sowing to each date of observation *i.e.* 50 per cent flowering and physiological maturity. Heat use efficiency (HUE) for seed yield was computed by following method as described by Rajput (1980).

$$\mathbf{HTU} = \frac{\textbf{Seed yield}}{\textbf{Accumulated heat units}}$$

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of date of sowing :

The plant height, branches plant^{-1}, nodules plant^{-1} and their dry weight plant^{-1} were influenced significantly due to

Table 1 : Plant height (cm), branches plant^{-1} (No.) Nodules plant^{-1} (No.) and dry weight of nodules plant^{-1} (mg) of mungben as influenced by date of sowing and genotypes

Treatments	Plant height (cm)				Branches plant^{-1} (No.)			Nodules plant^{-1} (No.)			Dry weight of nodule plant^{-1} (mg)		
Date	20 DAS	40 DAS	60 DAS	At harvest	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	40 DAS	60 DAS	At harvest
Date of sowing													
July 20	22.97	54.63	61.62	62.64	1.85	2.61	2.95	18.67	32.19	22.63	16.89	26.61	21.19
July 30	19.59	38.84	43.91	44.43	1.60	2.23	2.58	17.01	30.49	20.70	14.81	24.31	18.72
August 9	16.15	31.25	35.46	36.64	1.31	1.86	2.13	15.33	26.45	17.42	12.18	21.11	15.13
C.D. (P=0.05)	1.90	1.78	1.93	2.46	0.17	0.29	0.32	1.10	1.42	1.42	1.27	0.72	0.77
Genotypes													
BM-4	19.45	42.14	48.21	48.34	1.56	2.22	2.50	17.35	29.83	20.59	15.00	24.30	19.00
RM-03-79	19.40	42.07	46.47	47.08	1.55	2.20	2.48	16.87	29.81	20.27	14.76	23.70	18.61
RM-03-71	20.93	44.96	51.87	52.28	1.84	2.53	2.90	18.76	31.48	22.14	18.00	25.93	20.99
ML-1`31	18.06	37.92	42.64	43.88	1.35	1.92	2.23	15.20	27.92	18.44	11.01	21.95	15.26
Pusa 1072	18.71	38.78	43.53	45.06	1.44	2.05	2.37	16.17	28.89	19.10	12.18	22.58	16.17
COGG 973	20.89	43.39	49.26	50.78	1.75	2.50	2.84	17.68	30.37	20.96	16.80	25.60	20.05
C.D. (P=0.05)	1.43	2.80	3.75	3.10	0.18	0.26	0.24	1.24	1.64	1.54	1.45	1.25	1.04

Table 2 : Accumulated growing degree days (AGDD), accumulated photothermal units (APTU) and accumulated heliothermal units (AHTU) at 50% flowering and maturity and heat use efficiency (HUE) at maturity as influenced by date of sowing and genotypes of mungbean

Treatments	AGDD		APTU		AHTU		HUE (kg ha^{-1} ^{0}C day^{-1})	Days to	
Date	50% flowering	Maturity	50% flowering	Maturity	50% flowering	Maturity		50% flowering	Maturity
Date of sowing									
July 20	703.53	1261.19	9433.86	16654.9	2584.56	4734.59	0.62	40	73
July 30	682.20	1213.74	8794.13	15296.8	2358.34	5140.49	0.50	39	70
August 9	646.42	1186.07	8030.25	14480.8	1825.98	5397.96	0.34	38	69
Genotypes									
BM-4	682.91	1226.80	8888.23	15567.0	2277.55	5145.56	0.55	39	71
RM-03-79	677.11	1214.75	8732.74	15504.7	2250.29	5060.48	0.48	39	70
RM-03-71	703.56	1249.88	9001.29	15906.4	2329.53	5346.71	0.59	41	72
ML-1`31	647.90	1187.27	8432.24	15022.4	2180.71	4789.29	0.34	37	69
Pusa 1072	659.48	1204.90	8508.96	15233.6	2201.51	4945.26	0.38	38	70
COGG 973	693.33	1238.40	8953.04	15630.9	2298.18	5249.78	0.57	40	72

Table 3: Yield attributing characters and seed yield (kg ha^{-1}) of mungbean as influenced by date of sowing and genotypes

Treatments	pods plant^{-1} (No)	Seeds pod^{-1} (No)	Seeds plant^{-1} (No)	100 seeds weight (g)	Seed yield (kg ha^{-1})
Date of sowing					
July 20	19.29	11.59	229.08	2.99	833.04
July 30	17.72	10.66	193.66	2.94	642.96
August 9	14.92	9.66	149.39	2.91	440.07
C.D. (P=0.05)	1.37	0.84	25.74	NS	61.92
Genotypes					
BM-4	17.60	11.03	195.39	3.05	727.23
RM-03-79	17.53	9.72	172.05	2.97	620.33
RM-03-71	19.66	14.12	279.02	3.34	801.57
ML-131	14.20	7.37	111.92	2.46	439.02
Pusa 1072	16.00	8.44	136.02	2.73	487.53
COGG 973	18.90	13.14	249.87	3.13	756.45
C.D. (P=0.05)	1.80	1.14	25.01	0.28	63.03

dates of sowing (Table 1). The maximum plant height, branches plant^{-1}, nodules plant^{-1} and their dry weight plant^{-1} was recorded in July 20 sowing which was significantly higher than other dates of sowing *i.e.* July 30 and August 9. There was linear decline in plant height, branches plant^{-1}, nodules plant^{-1} and their dry weight plant^{-1} with delay in planting. Similar observations were noted by Pramanik *et al.* (2002). It was observed that the earliest sowing of mungbean gave taller plants due to favorable temperature and greater soil moisture as compared to low temperature and reduced soil moisture in late sowing.

With delay in sowing, days to 50 per cent flowering as well as days to maturity were reduced in all the genotypes (Table 2). On an average days to 50 per cent flowering were 40, 39 and 38 and days to maturity were 73, 70 and 69 under July 20, July 30 and August 9 sowings, respectively. In early sown crop availed more growing degree days (GDD), photothermal units (PTU) and heliothermal units (HTU) at 50per cent flowering and with each delay in sowing GDD, PTU and HTU decreased. Almost similar trend was observed for maturity in GDD and PTU. But HTU was observed at maturity just reversed trend might be due to the fact that actual sunshine hours was increased in delayed sowing. However, July 20 sowing had the highest HUE and resulted in highest seed yield. So early sowing resulted in absorbing sufficient amount of heat units in short time due to high temperature.

The yield attributes, pods plant^{-1}, seeds pod^{-1}, seeds plant^{-1} and seed yield were influenced significantly due to dates of sowing (Table 3). The number of pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1} were highest under July 20 sowing while, minimum number of pods plant^{-1}, seeds pod^{-1} and seeds plant^{-1} were recorded in August 9. The observation on 100 seeds weight was not found significant due to different dates of sowing. Sowing on July 20 obtained significant higher seed yield than July 30 and August 9 sowings. Singh *et al.* (2010) also reported July 5th to 25th is the best time of sowing for *Kharif* mungbean under Punjab condition. There was a drastic reduction in seed yield in the case of August 9 sowing.

Performance of genotypes :

Among the mungbean genotypes, RM-03-79 produced the highest plant height, branches plant^{-1}, nodules plant^{-1} and their dry weight plant^{-1} which was significantly superior to rest of genotypes except COGG 973. However, the lowest plant height, branches plant^{-1}, nodules plant^{-1} and their dry weight plant^{-1} was recorded with genotypes Pusa 1072 but it was statistically at par with genotype RM-03-71. Interaction effects were noted to be non-significant for different periods under observation (Table 1).

On an average crop took 37 to 41 days to 50 per cent flowering and 69 to 72 days to maturity. Genotypes RM-03-79 took maximum time for 50 per cent flowering and maturity, respectively. In different genotypes, high variation in days taken to reach different phenological stages and agroclimatic indices *i.e.* GDD, PTU, HTU and HUE was observed during crop growth period. Genotypes RM-03-79 gave maximum value of GDD, PTU, HTU and HUE followed by COGG 973 as compared to other genotypes (Table 2).

Mungbean genotypes, RM-03-79 produced the higher number of pods plant^{-1}, seeds pod^{-1}, seeds plant^{-1} and 100 seed weight and also maximum seed yield which was significantly superior to rest of genotypes except COGG 973. However, the lowest number of pods plant^{-1}, seeds pod^{-1}, seeds plant^{-1}, 100 seed weight and seed yield was recorded with genotypes Pusa 1072 but it was statistically at par with genotype RM-03-71. Interaction effects were noted to be non-significant for different periods under observation (Table 3).

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