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DS BankarDepartment of Agriculture
Meteorology, VNMKV,
Parbhani, Maharashtra, India**SB Pawar**NARP, Aurangabad,
Maharashtra, India**GB Raut**Department of Agriculture
Meteorology, VNMKV,
Parbhani, Maharashtra, India

Studies on effect of weather parameters on green gram (*Vigna radiata* L.) varieties under different sowing dates

DS Bankar, SB Pawar and GB Raut

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Abstract

The experiment was conducted on experimental farm at Department of Agricultural Meteorology, College of Agriculture, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani, during *Kharif* season 2017 entitled "Influence of weather parameters on growth and yield of different genotypes of green gram (*vigna radiata*. L) under different sowing dates" to study the relationship between meteorological parameters and different sowing dates and its impact on yield of different genotypes green gram. The experiment was conducted in Spilt plot design with three replications. Treatments comprised of four sowing dates in main plot D₁ 24th MW, D₂ 26th MW, D₃ 28th MW and D₄ 30th MW with four varieties in sub plot *viz.* Vaibhav, BM-4, BM-2002-1 and BM-2003-2. The results obtained from the experiment revealed that all the biometric observations plant height, number of functional leaves, number of branches, dry matter, number of pods, pod length, number of seeds pod⁻¹ in *kharif* green gram were significantly highest in D₁ 24th MW (16th June) followed by D₂ 26th MW (30th June), D₃ 28th (14th July) and D₄ 30th MW (28th July) respectively. The green gram variety BM-2003-2 was found to be highly productive as compared to Vaibhav, BM-4, and BM-2002-1.

Keywords: Green gram, varieties, dates of sowing, weather parameter and yield

Introduction

Green gram (*Vigna radiata* L. Wilczek) is one of the most important pulse crops of global economic importance. It is locally called as moong or mug and belongs to the family *Leguminoceae*, it fixes atmospheric nitrogen and improves soil fertility by adding 20-25 kg N ha⁻¹. It has yield potential of around 2000 kg/ha⁻¹ but productivity is low (864 kg/ha⁻¹). (Md Tariqul Islam, 2015) [5]. Mung bean has originated in India and is a native of India and central Asia. It is grown in these areas since prehistoric period. In India green gram is mostly grown in Andhra Pradesh, Maharashtra, Orissa, Rajasthan, Gujarat, Madhya Pradesh, Punjab and Uttar Pradesh. (Vakeswaran *et al.*, 2016) [12]. Green gram (*Vigna radiata* L.) is a good source of high quality protein. It contains protein (25%), fats (1.5%), minerals (3.5%), fibre (4.1%) and carbohydrates (56.7). It also has remarkable quality of ascorbic acid when sprouted and also bear riboflavin (0.2 mg/100gm). It also contains minerals (3.54%), calcium (0.12%) and 334 Kcal of energy from 100 g of grain. Green gram can also be used as a cattle feed. After harvesting the pods, green plants are uprooted or cut from ground level and chopped into small pieces and fed to cattle. The seed husks can be soaked in water and used as cattle feed. Green gram being a leguminous crop, it has the capacity to fix the atmospheric nitrogen. Green gram is also used as green manure crop. It also helps in preventing soil erosion. It is a short duration crop. Being a short duration crop, it fits well in many intensive crop rotations (Bhowmick *et al.*, 2006) [2]. The weather parameters play an important role in deciding the success or failure of the crop, because they strongly influence the physiological expression and genetic potential of the crop. Solar radiation, temperature, soil moisture, relative humidity and bright sunshine hours are the important weather elements that influence the crop life cycle during growing season. (Pradeep Makone *et al.*, 2015) [8]. The optimum time is mainly dependent on prevailing agro-climatic conditions of an area besides the variety grown. Planting during the optimum period, therefore ensures better harmony between the plant and weather which ultimately results in higher crop yields (Venkateswarulu *et al.*, 1991) [13].

Corresponding Author:**DS Bankar**Department of Agriculture
Meteorology, VNMKV,
Parbhani, Maharashtra, India

Material and Methods

The field experiment was conducted during the *Kharif* 2017 at Research farm of Department of Agricultural Meteorology, college of Agriculture Parbhani. The experiment was laid out in Split plot design with three replications. Treatments comprised of four sowing dates in main plot D₁ 24th MW, D₂ 26th MW, D₃ 28th MW and D₄ 30th MW with four varieties in sub plot *viz.* Vaibhav, BM-4, BM-2002-1 and BM-2003-2. Gross and net plot sizes were 4.8 x 4.3 m² and 4.2 x 3.9 m², respectively. Sowing was done by dibbling method with spacing of row to row and plant to plant 30 x 10 cm. To maintain optimum plant population gap filling and thinning was carried out 10 and 15 days after sowing by keeping only one healthy seedling hill⁻¹. The soil analyzed in experimental field selected for experiment is uniform with typical medium soil having medium fertility and fairly good drainage. Pre-harvested Biometric observations Emergence count, Final plant stand, Height of plant (cm), Number of leaves plant⁻¹, Number of branches plant⁻¹, Dry matter plant⁻¹, Days to 50% flowering was taken on 15 DAS and subsequent observations were recorded at an interval of 15 days. Postharvest observations Number of pods plant⁻¹, Pod Length, Grain yield plant⁻¹ (g), Grain yield plot⁻¹ (kg), Grain yield ha⁻¹, Straw yield plot⁻¹ (kg), Straw yield ha⁻¹, Biological yield plot⁻¹ (kg), Test weight, Harvest index (%) recorded At time of harvest. Meteorological Observations Maximum temperature (°C), Minimum temperature (°C), Rainfall (mm), Rainy days, Relative humidity (%), Winds speed (km/hr), Bright sunshine hours (hrs) recorded daily.

Results and Discussion

Growth studies

Plant height

Data in Table (1) revealed that the mean plant height was significantly influenced by different sowing dates and variety. The plant height was found to be highest in first date of sowing D₁ 24th MW i.e. (59.13 cm) at the time of harvest as compared to other sowing dates. Lowest plant height was recorded in D₄ 30th MW during all growth stages of crop. The possible reason could be that the early sowing date D₁ 24th MW of green gram crop had longer period for growth and development as compared to D₂ 26th MW, D₃ 28th MW and D₄ 30th MW sowing dates. Therefore, plant height reduced subsequently with delayed sowing. Similar results was obtained by Malik *et al.* (2003) [6]. The variety V₄ BM-2003-2 was found significantly superior among all varieties producing taller plant up to harvest. Interaction effect the mean plant height was non-significantly by sowing dates and varieties at all growth stages.

Number of functional leaves plant⁻¹

Data in Table (1) revealed that the Number of functional leaves plant⁻¹ was significantly influenced by different sowing dates and variety. The crop sown on D₁ 24th MW significantly produced higher number of functional leaves plant⁻¹ at 45 days after sowing i.e. (8.43) leaves and at harvest it reduced upto (5.72). In the present study higher number of leaves was obtained in D₁ 24th MW which may be due to favorable environmental factors (temperature, rainfall and relative humidity etc.) Plant growth is strongly related to its genetic characteristics and is influenced by various environmental conditions. Similar results obtained by Malik *et al.* (2003) [6]. The variety V₄ BM-2003-2 was found to be superior in producing maximum number of leaves plant⁻¹ i.e. (8.02) over the varieties. Similar results was obtained by Singh *et al.*

(2010) [10]. Interaction effect Mean number of leaves plant⁻¹ was non-significantly by sowing dates and varieties during different crop growth stages.

Number of branches plant⁻¹

Data in Table (1) revealed that the number of branches plant⁻¹ was significantly influenced by different sowing dates and variety. Highest mean no. of branches plant⁻¹ was recorded in D₁ 24th MW i.e. (7.35) all other sowing dates. The probable reason for this may be suitable rainfall, rainy day and relative humidity at branching stage of D₁ 24th MW date of sowing. The variety V₄ BM-2003-2 recorded highest number of branches plant⁻¹ i.e. (7.30) was significantly superior over the variety. The probable reason for this may be the genetic potential of the genotype that has helped in producing more number of braches plant⁻¹. Similar result obtained by Bhise *et al.* (2010) [11]. The number of branches produced plant⁻¹ non-significantly the interaction effect of sowing dates and varieties.

Total dry matter production plant⁻¹ (g)

Data in Table (1) revealed that the total dry matter production plant⁻¹ (g) was significantly influenced by different sowing dates and variety. The mean total dry matter accumulation per plant was significantly influenced by sowing dates at different stages of crop growth. The treatment D₁ 24th MW produced higher dry matter plant⁻¹ (12.19 g). The lowest dry matter plant⁻¹ was produced in D₄ 30th MW sowing date. D₁ 24th MW sowing date accumulated highest dry matter due to favorable weather conditions i.e. solar radiation, bright sun shine hours, rainfall and relative humidity etc. during crop growing period than other sowing dates. Due to delayed sowing the rate of photosynthesis, biomass production, seed set and grain yield in crop growth stages was reduced which ultimately affected the total dry matter production. Similar result was reported by Nisar and Khan (2003) [7]. The variety V₄ BM-2003-2 produced maximum dry matter plant⁻¹ i.e. (12.05 g) at all stages of crop. The interaction effect between sowing dates and varieties was found to be non-significant at all stages of crop.

Days to 50% flowering

Data in Table (1) revealed that the Days to 50% flowering was significantly influenced by different sowing dates and variety. The highest days to 50% flowering was observed in D₂ 26th MW about 40 days and lowest was observed in D₃ 28th MW about 35 days. The earlier sown crop required more time to attain 50 % flowering. Whereas, late sown crop required less time to attain 50 % flowering. The number of days required to attain 50 % flowering decreased with delay in sowing dates. This is attributable to the prevalence of higher temperature, soil moisture stress and more bright sunshine hours in delayed sowings as compared initial sowing. Days to 50% flowering was highest in variety V₁ Vaibhav i.e. 39 days and lowest in V₂ BM-4 i.e. 36 days for flowering. Similar result obtained by Choudhary *et al.* (1989) [3]. The interaction effect between sowing dates and varieties was found to be non-significant at all stages of crop.

Number of pods plant⁻¹

Data in Table (1) revealed that the Number of pods plant⁻¹ was significantly influenced by different sowing dates and variety. The maximum number of pods plant⁻¹ were observed with the crop sown on D₁ 24th MW which was produced (9.68) pods plant⁻¹. It was found that delayed sowing of green

gram crop caused decrease in number of pods plant⁻¹. The reason could be that the early sown crop got optimum conditions during growing period while the late sown crop was adversely affected. Similar result was reported by Rana *et al.* (2006) [9]. In variety higher number of pods plant⁻¹ was produced by V₄ BM-2003-2 i.e. (9.83). The interaction effect between sowing dates and varieties was found to be non-significant at all stages of crop.

Post harvest studies

Seed yield (kg ha⁻¹)

Data in Table (2) revealed that the mean seed yield was (736 kg/ha⁻¹) which significantly influenced by different sowing dates and varieties. The crop sown on D₁ 24th MW produced highest seed yield (970 kg/ha⁻¹) yield decreased with delay in

sowing. Reduction in the seed yield might be due to adverse effects of weather parameters particularly rainfall, temperature and relative humidity on the growth and development of the crop. Generally the variations in meteorological parameters at different sowing dates exert their influence on the plant growth and ultimately yield. The early attainment of flowering under delayed sowing i.e. D₃ 28th MW and D₄ 30th MW sowing dates brought about significant reduction in biomass production affecting the yield of crop. Similar result observed by Taleei *et al.* (1999) and Devidas *et al.* (2014) [11, 4]. The variety V₄ BM-2003-2 produced maximum seed yield (819 kg/ha⁻¹) which was significantly superior over other varieties. The interaction effect between sowing dates and varieties was found to be non-significant at all stages of crop.

Table 1: Periodical mean growth and yield attributing characters of green gram as influenced by different treatments

Treatment	Plant height (cm)	No. of leaves plant ⁻¹	No. of branches plant ⁻¹	Dry matter production plant ⁻¹ (g)	Days to 50% flowering	No. of pods plant ⁻¹
Sowing dates (D)						
D ₁ : 24 th MW	59.13	8.43	7.35	12.19	38.00	9.68
D ₂ : 26 th MW	49.62	7.43	6.48	12.03	40.00	9.03
D ₃ : 28 th MW	45.00	6.43	5.30	11.19	35.00	7.90
D ₄ : 30 th MW	27.05	6.03	4.54	10.83	37.00	6.40
SE ±	1.33	0.21	0.19	0.34	0.62	0.26
CD at 5%	4.59	0.71	0.66	1.16	1.82	0.89
Varieties (V)						
V ₁ : Vaibhav	42.13	6.69	5.35	11.15	39.00	8.03
V ₂ : BM-4	41.83	6.27	5.23	11.01	36.00	6.61
V ₃ : BM-2002-1	45.99	7.05	5.80	11.93	37.50	8.55
V ₄ : BM-2003-2	50.85	8.02	7.30	12.05	37.50	9.83
SE ±	1.28	0.43	0.36	0.29	0.75	0.21
CD at 5%	3.83	1.29	1.07	0.86	2.19	0.63
Interaction (D X V)						
SE ±	3.51	1.10	0.75	0.12	1.50	0.80
CD at 5%	NS	NS	NS	NS	NS	NS
Mean	45.20	7.04	5.92	11.54	37.50	8.25

Table 2: Yield and yield attributes of green gram varieties under different treatments

Treatment	Seed yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)
Sowing dates (D)				
D ₁ : 24 th MW	970	2060	3030	32.02
D ₂ : 26 th MW	910	1949	2859	31.82
D ₃ : 28 th MW	642	1529	2171	29.58
D ₄ : 30 th MW	421	1088	1508	27.85
SE ±	22.74	50.06	69.61	0.91
CD at 5%	78.69	173.25	240.90	3.13
Varieties (V)				
V ₁ : Vaibhav	703	1625	2322	29.81
V ₂ : BM-4	666	1596	2270	28.93
V ₃ : BM-2002-1	753	1652	2391	31.20
V ₄ : BM-2003-2	819	1753	2585	31.33
SE ±	18.19	41.87	61.05	0.57
CD at 5%	54.55	125.53	183.03	1.70
Interaction (D X V)				
SE ±	47.96	64.49	167.03	0.41
CD at 5%	NS	NS	NS	NS
Mean	736	1656	2392	30.32

Straw yield (Kg ha⁻¹)

Data in Table (2) revealed that the Straw yield (Kg/ ha⁻¹) was significantly influenced by different sowing dates and variety. The mean straw yield of green gram was about (1656 kg/ha⁻¹). The sowing on D₁ 24th MW produced highest yield 2060 kg/ha⁻¹ straw yield which was superior over the other sowing

dates. Similar result observed by Taleei *et al.* (1999) [11]. The straw yield was significantly influenced by different varieties. Maximum straw yield (1753 kg/ha⁻¹) was observed in variety V₄ BM-2003-2 which was significantly superior over the variety. The interaction effect between sowing dates and varieties was found to be non-significant at all stages of crop.

Biological yield (Kg ha⁻¹)

Data in Table (2) revealed that Biological yield (Kg/ha⁻¹) was significantly influenced by different sowing dates and variety. The average biological yield was (2392 kg/ha⁻¹). The sowing D₁ 24th MW recorded highest biological yield (3030 kg/ha⁻¹). The highest biological yield of green gram in D₁ 24th MW date of sowing might be because of environmental conditions favorable for proper grain filling and dry matter accumulation as compared to other sowing dates. Similar result observed by Taleei *et al.* (1999) ^[11]. Maximum biological yield was observed in variety V₄ BM-2003-2 i.e. (2585 kg/ha⁻¹) which was significantly superior over variety. The interaction effect between sowing dates and varieties was found to be non-significant at all stages of crop.

Harvest Index (%)

Data in Table (2) revealed that the mean harvest index of green gram was (30.32%) It was influenced due to sowing dates and varieties. The sowing of crop at D₁ 24th MW recorded higher (32.02%) harvest Index over other sowing dates. The highest harvest index was recorded by variety V₄ BM-2003-2 i.e. (31.33%) than rest of the three varieties. Same result was reported by Rana *et al.* (2006) ^[9]. The interaction effect between sowing dates and varieties was found to be non-significant at all stages of crop.

Conclusion

On the basis of the field experimentation conducted, it could be concluded that among different sowing dates, the sowing of green gram crop at D₁ 24th MW was found to be optimum for achieving higher seed yield (970 kg/ha⁻¹) followed by D₂ 26th MW (910 kg/ha⁻¹), D₃ 28th MW (642 kg/ha⁻¹) and D₄ 30th MW (421 kg/ha⁻¹). The green gram variety V₄ BM-2003-2 highest seed yield about (819 kg/ha⁻¹) was found to be highly productive as compared to V₃ BM-2002-1 (753 kg/ha⁻¹), V₁ Vaibhav (703 kg/ha⁻¹) and V₂ BM-4 (666 kg/ha⁻¹).

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