



Correlation Studies in Weather Parameters and Yield Of Black Gram Varieties Under Changing Weather Conditions

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ABSTRACT

An experiment was conducted at Department of Agril. Meteorology, College of Agriculture, Vasant Rao Naik Marathwada Krishi Vidyapeeth, Parbhani, during Kharif season 2016 entitled "Performance of black gram (Vignamungo(L.) Hepper) varieties in changing weather condition" to find out most suitable week for sowing of black gram in kharif season, and to study the relationship between meteorological parameters and different dates of sowing in black gram. The experiment was conducted in split plot design with three replications. Treatments comprised of four sowing dates in main plot treatment i.e. D1 (25th MW), D2 (27th MW), D3 (29th MW) and D4 (31th MW), with three varieties in sub plot viz. TAU-1, BDU-1 and AKU-15. The experiment was sown with spacing 30×10 cm. Gross and net plot size viz. 4.2 m x 3.5 m and 3.6 m x 3.1 m respectively. The sowing was done by dibbling method on respective dates of sowing. The results obtained from the experiment revealed that all the biometric observations (plant height (cm), number of functional leaves, dry matter (gm), number of pods per plant and number of nodules per plant) and yield of kharif black gram were significantly highest in second date 27th MW (02 to 08th July) as compared to other dates of sowing. The black gram variety BDU-1 was found to be highly productive as compared to TAU-1 and AKU-15. The correlation study was carried out between weather variables prevailed during (P₁) to (P₆) growth stages of different varieties under different sowing dates. The rainfall, rainy day, RH-I and RH-II has been positively correlated with seed black gram yield at P₂ and P₃ stages however, it was negatively correlated at P₅ and P₆ stages of TAU-1, BDU-1 and AKU-15 varieties. The maximum temperature has positively correlated with seed black gram yield at P₁, P₅ and P₆ stages and minimum temperature at P₁, P₂ and P₃ stages however maximum temperature was negatively correlated at P₂ and P₃ stages of all varieties. The BSS has negatively correlated with seed black gram yield at all stages except P₅ and P₆ stages has positively correlated of all varieties.

Key words : Black gram, varieties, sowing dates, yield and phenological stages.

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INTRODUCTION

Black gram (Vignamungo L. Hepper, 2n=22) is a self-pollinating and widely cultivated grain legume [5]. It is one of the most important pulse crops grown in India. The cultivated black gram belongs to the family Leguminosae, sub-family Papilionaceae. It is mainly a day neutral warm season crop commonly grown in semi-arid to sub-humid low land tropics and sub-tropics. This crop is grown in cropping systems as a mixed crop, cash crop, sequential crop besides growing as sole crop under residual moisture conditions. The crop is resistant to adverse climatic conditions and improves the soil fertility by fixing atmospheric nitrogen in the soil. Black gram is consumed in the form of 'dal' (whole or split husked and unhusked) or parched. It is the chief constituent of 'papad' and also of 'bari' (special balls) which makes a delicious curry. Seeds are used in the preparation of many popular dishes. It is one of the most important components in the preparation of famous south Indian dishes, e.g. dosa, idli, vada, halwa and imrati. etc. Black gram differs from other pulses in its peculiarity of attaining some mucilaginous pasty character, when ground up with water.

Black gram has been distributed mainly in tropical to subtropical countries where it is grown in Kharif and summer season. It is widely grown in India, Pakistan, Bangladesh, Myanmar, Thailand, Philippines, China and Indonesia [7] and some countries of southeast Asia. In India black gram is very popularly grown

in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal, Punjab, Haryana, Tamilnadu and Karnataka.

In India, Black gram is grown on 29 lakh ha area with total production of 15.9 lakh tonnes and productivity of 532 kg ha⁻¹. In Maharashtra it occupies an area of 3.65 lakh ha with total production of 2.06 lakh tonnes and the productivity of 299 kg ha⁻¹ [1].

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. It is well known that yield from any given crop or variety depends on the availability of certain optimum rainfall, solar radiation, temperature, soil moisture, heat units etc. during different stages of crop growth. Among different management factors, sowing time plays a key role in obtaining higher yield. Time of sowing is known to influence the yield and growth of black gram. [11]. 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 [12].

The present study aimed at to evaluate the correlation coefficients and path coefficients in order to formulate selection criteria for evolving high yielding genotypes and to estimate the contribution of yield components on yield and their association in black gram.

MATERIALS AND METHODS

The experiment was conducted at experimental farm, Department of Agricultural Meteorology, College of Agriculture, Vasantrya Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* 2016.

The experiment was conducted in Split plot design with three replications. Treatments comprised of four sowing dates in main plot D₁(25th MW), D₂ (27th MW), D₃ (29th) and D₄ (31th MW), with three varieties in sub plot *viz.* TAU-1 , BDU-1 and AKU-15. The experiment was sown with spacing 30×10cm. Gross and net plot size *viz.* 4.2 x 3.5 m² and 3.6 x 3.1m² respectively. The periodical observations on growth characters, post harvest observation and yield contributing characters of black gram and micrometeorological parameters were recorded to assess the treatments effects.

Correlation between Black gram yield and weather parameters.

Simple correlation between weather parameters *i.e.* Rainfall, Rainy days, Maximum temperature, Minimum temperature, relative humidity, Evaporation, Bright sun shine hours and wind velocity on the development of black gram was estimated to know the correlation between these weather parameters and black gram yield.

The procedure and formula described were significance was tested.

$\Sigma x y$

$r = \frac{\Sigma x y}{\sqrt{(\Sigma x) (\Sigma y)}}$

Where,

$r =$ Correlation coefficient

$x =$ Independent variable (attributes)

$y =$ Dependent variable (yield).

RESULTS AND DISCUSSION

Growth studies

Plant height : Data on periodical mean plant height (cm) recorded at various stages of crop growth revealed that given in table.1 the mean plant height progressively increased and reached to maximum (37.09 cm) at harvest. The rate of increase in plant height was rapid from 15 to 45 days and thereafter it increased gradually upto the harvest. The plant height was observed significantly highest in second date of sowing *i.e.* D₂ (27 MW) 37.09 cm at harvest than other date of sowing at all stages of crop growth, the plant height was significantly highest at 45 DAS. Lowest plant height was recorded in D₄ during all growth stages of crop. Similar results were reported by Choudhary *et al.* [2].

The variety BDU-1 was found significantly superior over other varieties in producing taller plant up to harvest. The mean plant height of BDU-1 is significantly highest at harvest stage (35.34 cm) over the rest of varieties TAU-1, and AKU-15 during all the growth stages. It might be due to genetic character of BDU-1. These findings are in line with earlier findings by Choulwar *et al.* [3].

Mean number of branches plant⁻¹

Data regarding mean no. of branches plant⁻¹ presented in table 1 revealed that the no. of branches increased gradually from 30 DAS up to 60 days then after constant up to at harvest. The rate of increase was faster between 30 to 45 DAS.

The maximum mean no. of branches per plant (6.85) was recorded due to D₂ (2nd July) significantly superior over all other sowing dates at harvest. Similar results were obtained by Sharma *et al.* (1989). And variety BDU-1 (V₂) recorded highest no. of branches per plant (5.58) which was significantly superior over TAU-1 (V₁) and AKU-15 (V₃) at harvest.

The no. of branches produced per plant was non significantly due to the interaction effect of sowing dates and varieties.

Number of Nodules per plant

The number of nodule were increased gradually up to 50 DAS and thereafter with the advancement in the growth of crop the number of nodules decreased gradually up to harvest. The maximum number of nodules were observed at 50 DAS.

The maximum number of nodules (62.26) were observed in the crop sown at 50 DAS D₂(27 MW) and found significantly superior over rest of other sowing dates given in table.1. Similar results were obtained by Singh *et al* (2010).And variety BDU-1, which was significantly superior over varieties TAU-1 and AKU-15. However after 50 DAS, number of nodules were decreased gradually up to harvest due to varietal effect.

Post harvest studies :

Number of pods per plant

The mean number of pods per plant was 23.38. Persual of data presented in Table.1 indicted that maximum number of pods per plant were observed with the crop sown on D₂(27 MW) was found significantly superior it produced (25.98) pods per plant over the rest of sowing dates. Similar result was reported by Faroda *et al.* [6]. And variety BDU-1 (V₂) i.e. 24.54 was significantly superior over variety TAU-1 (V₁) i.e.23.77, and variety AKU-15 (V₃) i.e. 21.83 [6].

Pod weight per plant

Pod weight per plant of black gram was significantly influenced by sowing dates. The crop sowing at D₂27 MW i.e. (2nd July) has produced highest pod weight per plant i.e. 8.75 (gm) and significantly superior over rest of the sowing dates shown in table 1. The lowest pod weight per plant recorded by crop sown on D₄(31 MW) (30th July) i.e. 7.56 (gm). Similar results were obtained by Singh *et al.* (2010) and variety BDU-1 (V₂) produced maximum pod weight per plant (8.24 gm) and found significantly superior as compared to varieties TAU-1 (V₁) i.e. 8.00 (gm) and AKU-15 (V₃) i.e. 6.02 (gm). Similar results were obtained by Sharma *et al.* [10].

Seed yield per plant

The mean seed yield per plant was (3.82 gm) presented in table 2. seed yield per plant in black gram. The crop sown at D₂(27 MW) produced maximum seed yield per plant (4.71 gm) was significantly influenced as compared to the rest of sowing dates. Similar results were reported by Rao and Suryawanshi [9] and variety BDU-1 (V₂) produced maximum seed yield per plant i.e. (4.25 gm) was significantly superior over TAU-1 (3.88 gm) and AKU-15 (3.34 gm). Similar results were reported by Rana *et al.* [8].

Test weight

The test weight (1000 seed weight) was not influenced by different sowing dates, varieties and their interactions. The effect of different sowing dates on tests weight (1000 seeds) was found to be non significant. But the highest test weight was observed at D₂(27 MW) (45.08 gm) followed by sowing date D₁(42.35 gm), D₃ (40.98 gm) and D₄ (38.71) shown in table 2. Similar results were reported by Rana *et al.* [8] and variety BDU-1 (V₂) produced maximum test weight i.e. (43.26 gm) was significantly superior over TAU-1 (42.15 gm) and AKU-15 (39.93gm).

Yield

Mean seed yield straw and biological yield was 1064 kg ha⁻¹, 2115kg ha⁻¹ and 3180kg ha⁻¹ which was significantly influenced by different sowing dates and varieties respectively given in table 2.

The crop sown on D₂(27 MW) produced maximum seed, straw and biological yield (1218 kg ha⁻¹), (2448kg ha⁻¹) and (3666kg ha⁻¹) respectively which was significantly superior over rest of sowing dates and variety V₂ produced maximum seed, straw and biological yield (1163kg ha⁻¹), (2312kg ha⁻¹) and (3475kg ha⁻¹) respectively which was significantly superior over rest of varieties. Choudhary *et al.* [2] reported similar results.

Correlation studies Growth &Yield attributing characters :

The result given in table 3 The rainfall has been significantly negative correlated with Growth & Yield attributing characters of Black gram varieties at harvest stage of TAU-1, BDU-1 and AKU-15 varieties however, only number of branches per plant has been non significant of TAU-1 variety.

The Rainy day, Maximum temperature, Minimum temperature and Bright sunshine hours has been non significantly with Growth & Yield attributing characters of Black gram varieties at harvest stage of TAU-1, BDU-1 and AKU-15 varieties however, only number of branches per plant of TAU-1 variety and Test weight of BDU-1 variety has been significantly positive correlation has been with minimum temperature.

The Morning and evening relative humidity has been significantly negative correlated with Growth & Yield attributing characters of Black gram varieties at harvest stage of TAU-1 and BDU-1 varieties however , only pod weight per plant has been significant of AKU-15 variety with morning relative humidity.

Correlation studies Yield :

The rainfall , rainy day, RH-I and RH-II has been positively correlated with seed black gram yield at P₂ and P₃ stages however , it was negatively correlated at P₅ and P₆ stages of TAU-1, BDU-1 and AKU-15 varieties. The maximum temperature has positively correlated with seed black gram yield at P₁, P₅ and P₆ stages and minimum temperature at P₁, P₂ and P₃ stages however maximum temperature was negatively correlated at P₂ and P₃ stages of all varieties. The BSS has negatively correlated with seed black gram yield at all stages except P₅ and P₆ stages has positively correlated of all varieties.

Table 1 :Mean Growth and Yield attributing characters of black gram as influenced by various treatments at harvest.

Character Treatment	Plant height (cm)	number of branches plant ⁻¹	number of nodules plant ⁻¹ 50 DAS	No. of pods plant ⁻¹	Pod weight plant ⁻¹ (g)
Sowing dates (D)					
D ₁ -MW 25	33.72	5.30	57.78	23.81	7.78
D ₂ -MW 27	37.09	6.85	62.26	25.98	8.75
D ₃ -MW 29	32.98	4.10	56.79	22.64	7.56
D ₄ -MW 31	30.40	3.81	53.18	21.08	6.81
SE ±	0.20	0.07	0.28	0.08	0.06
CD at 5 %	0.70	0.23	0.99	0.27	0.20
Varieties (V)					
V ₁ : TAU-1	34.50	4.91	58.81	23.77	8.00
V ₂ : BDU-1	35.34	5.58	59.93	24.54	8.24
V ₃ : AKU-15	30.81	4.55	53.90	21.83	6.93
SE ±	0.16	0.08	0.23	0.03	0.05
CD at 5 %	0.49	0.23	0.68	0.08	0.14
Interaction (D X V)					
SE ±	0.64	0.30	0.90	0.10	0.18
CD at 5 %	NS	NS	NS	NS	NS
Mean	33.55	5.01	57.50	23.38	7.73

Table 2:Yield of black gram ¹as influenced by various treatments at harvest.

Treatments	Seed yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Seed weight plant ⁻¹ (g)	Test weight (g)
Sowing dates (D)					
D ₁ : MW 25	1110	2220	3330	4.01	42.35
D ₂ : MW 27	1218	2448	3666	4.71	45.08
D ₃ : MW 29	1010	1999	3009	3.44	40.98
D ₄ : MW 31	921	1795	2716	3.14	38.71
SE ±	5.34	10.61	25.20	0.03	0.04
CD at 5 %	18.51	36.72	87.21	0.09	0.15
Varieties (V)					
V ₁ : TAU-1	1081	2147	3228	3.88	42.15
V ₂ : BDU-1	1163	2312	3475	4.25	43.26
V ₃ : AKU-15	950	1888	2838	3.34	39.93
SE ±	3.47	6.78	9.26	0.02	0.03
CD at 5 %	10.42	20.33	27.7	0.06	0.09
Interaction (D x V)					
SE ±	13.91	27.13	37.04	0.08	0.12
CD at 5 %	NS	NS	NS	NS	NS
G.Mean	1064	2115	3180	3.82	41.78

Table.3. Correlations between weather parameters and Growth &Yield attributing characters of Black gram varieties at harvest.

weather parameters	Plant height (cm)	number of branches plant ⁻¹	No. of pods plant ⁻¹	Pod weight plant ⁻¹ (g)	Seed weight plant ⁻¹ (g)	Test weight (g)
V₁(TAU-1)						
Rainfall	-0.780**	-0.293	-0.843**	-0.818**	-0.881**	-0.780**
Rainy day	-0.251	-0.217	-0.187	-0.164	0.178	-0.251
T Max	0.116	0.494	0.098	0.158	0.330	0.116
T Min	0.378	0.827**	0.313	0.374	0.359	0.378
RH-I	-0.622*	-0.824**	-0.603*	-0.652*	-0.733**	-0.622*
RH-II	-0.455	-0.744**	-0.433	-0.488	-0.597*	-0.455
BSS	0.303	0.809**	0.213	0.271	0.160	0.303
V₂ (BDU-1)						
Rainfall	-0.736**	-0.867**	-0.736**	-0.731**	-0.905**	-0.699*
Rainy day	-0.025	0.100	-0.025	-0.431	-0.044	0.024
T Max	0.371	0.306	0.371	-0.047	0.139	0.441
T Min	0.551	0.382	0.551	0.289	0.267	0.606*
RH-I	-0.803**	-0.733**	-0.803**	-0.485	-0.617	-0.846**
RH-II	-0.669*	-0.590*	-0.669*	-0.307	-0.453	-0.724**
BSS	0.421	0.205	0.421	0.269	0.124	0.468
V₃ (AKU-15)						
Rainfall	-0.945**	-0.880**	-0.945**	-0.818**	-0.880**	-0.945**
Rainy day	-0.161	-0.382	-0.161	-0.164	-0.382	-0.161
T Max	-0.083	-0.291	-0.083	0.158	-0.291	-0.083
T Min	0.060	-0.061	0.060	0.374	-0.061	0.060
RH-I	-0.425	-0.245	-0.425	-0.652*	-0.245	-0.425
RH-II	-0.241	-0.049	-0.241	-0.488	-0.049	-0.241
BSS	-0.055	-0.106	-0.055	0.271	-0.106	-0.055

(* Significant at 5% , ** Significant at 1%)

Table.4. Correlations between weather parameters and different Phenophases of Black gram with seed yield of different varieties.

Weather Parameters	Phenological stages of Black gram					
	P ₁	P ₂	P ₃	P ₄	P ₅	P ₆
V₁ (TAU-1)						
Rainfall	-0.152	0.818**	0.542	0.183	-0.790**	-0.867**
Rainy day	0.031	0.792**	0.610*	-0.269	-0.463	-0.630*
T Max	0.647*	-0.507	-0.986**	-0.200	0.941**	0.671*
T Min	0.834**	0.744**	0.872**	0.448	-0.463	0.029
RH-I	-0.709*	0.361	0.624*	0.343	-0.486	-0.671*
RH-II	-0.306	0.669*	0.870**	0.141	-0.851**	-0.772**
BSS	-0.171	-0.786**	-0.887**	-0.464	0.892**	0.587*
V₂ (BDU-1)						
Rainfall	-0.272	0.873**	0.495	0.180	-0.834**	-0.803**
Rainy day	-0.045	0.848**	0.506	-0.235	-0.520	-0.606*
T Max	0.697*	-0.616*	-0.975**	-0.076	0.928**	0.567
T Min	0.784**	0.789**	0.807**	0.406	-0.520	0.091
RH-I	-0.741*	0.479	0.523	0.350	-0.574*	-0.567
RH-II	-0.377	0.753**	0.834**	0.061	-0.882**	-0.682*
BSS	-0.122	-0.842**	-0.883**	-0.361	0.919**	0.485
V₃ (AKU-15)						
Rainfall	-0.209	0.735*	0.686*	-0.179	-0.642*	-0.775**
Rainy day	0.178	0.695*	0.482	-0.512	-0.265	-0.803**
T Max	0.465	-0.591*	-0.945**	0.176	0.725*	0.367
T Min	0.518	0.578	0.769*	0.040	-0.265	-0.169
RH-I	-0.486	0.642*	0.507	0.004	-0.422	-0.367
RH-II	-0.141	0.652*	0.890**	-0.296	-0.687*	-0.605*
BSS	-0.387	-0.683*	-0.649*	-0.063	0.742*	0.489

(* Significant at 5% , ** Significant at 1%)Phenological stages of black gram

P₁: Sowing to Emergence P₂: Emergence to Branching P₃:Branching to Flowering P₄:Flowering to Pod formation P₅:Pod formation to Dough stage P₆:Dough stage to Maturity

CONCLUSION

Result showed that Among different sowing dates in black gram, the sowing at D₂ (27 MW) was found optimum for achieving all growth and yield attributing characters and higher seed yield 1218 kg ha⁻¹ followed by D₁(25 (MW), D₃ (27 MW) and D₄ (31 MW) and variety BDU-1 found highly productive as compared to TAU-1, and AKU-15. Significant positive correlation with seed yield during the phenophases P₂, P₃ (Tmin., RH-I and RH-II), and negative correlation with seed yield during the phenophases P₅ and P₆ (Tmin., RH-I and RH-II) given n table 4.

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