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Crop weather relationship studies in black gram (*Phaseolus mungo* L.) Under different sowing windows

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Abstract
A field experiment was carried out during kharif 2019-20 at Research Farm of College of Agriculture, Nagpur to study the "Crop weather relationship studies in Black gram (*Phaseolus mungo* L.) under different sowing windows". The experiment was laid out in split plot design with four sowing dates *viz*. D_1 (26th MW), D_2 (27th MW), D_3 (28th MW) and D_4 (29th MW), and three varieties *viz*. V_1 (TAU-1), V_2 (AKU-15) and V_3 (Yashoda-58). Growth attributing characters such as plant height, total number of branches plant^{-1}, dry matter accumulation plant^{-1} and maturity duration was significantly influenced by sowing 26th MW and variety TAU-1. The yield attributing character *viz*. number of pod plant^{-1}, weight of dry pod plant^{-1}, grain yield plant^{-1}, test weight, straw yield, biological yield and harvest index recorded maximum in sowing of 26th MW, and variety TAU-1.

Keywords: Black gram, *Phaseolus mungo* L., varieties and sowing windows

Introduction
Black gram belongs to the family Fabaceae and the genus *Vigna*. Only seven species of the genus are cultivated as pulse crops, five Asian species of subgenus *Ceratropis*, *Vigna mungo* (black gram), *V. radiata* (mung bean), *V. aconitifolia* (Mothbean), *V. angularis* (azuki bean) and *V. umbellate* (rice bean) and two African species of subgenus *Vigna*, *Vigna unguiculate* (cowpea) and *V. subterranean* (the Bambara groundnut) (Verdcourt, 1969) [9]. Black gram (*Vigna mungo* L. Hepper) is a member of the Asian *Vigna* crop group. It is a staple crop in the Central and South East Asia however, it is extensively used only in India and now grown in the Southern United States, West Indies, Japan and other tropics and subtropics. Black gram, the 3rd important crop group, was cultivated over an area of 5.44 Mha (kharif + rabi) and recorded a production of 3.56 Mt at productivity level of 655 kg ha^{-1}. This was the highest ever area, production and productivity in this crop. Major contributing states are MP, Rajasthan, AP, UP, Tamil Nadu, Maharashtra, Jharkhand and Gujarat. Black gram crop is also gaining momentum since 2015-16 and there has been phenomenal increase in its coverage. During 2017-18 the crop was cultivated over an area of >50 Lha. The success of this crop was released with a harvest of about 35 Lt at an ever highest yield levels of 352 kg/ha.
Black gram is native to India (Vavilov, 1926) [8]. The progenitor of black gram is believed to be Vigna mungo var. silvestris, which grows wild in India. There is a mention of black gram in Vedic texts such as Kautilya's "Arthashashtra" and "Charak Samhita". The ancient Sanskrit name of black gram was masha. Even today in Punjab, black gram is called mash and in West Bengal, it is called mash kalaya. In all other Indian languages, the name urd is used, which seems to have originated from the Tamil word ulundu. Vigna mungo is the Latin name of black gram (Nene, 2006) [4].

Materials and Methods
A field experiment was conducted to study the "Crop weather relationship studies in Black gram (*Phaseolus mungo* L.) Under different sowing windows", during *kharif* season of 2019-2020 at Agronomy Farm, College of Agriculture, Nagpur. Soil of the experimental site was loamy clay in texture, medium in available nitrogen, phosphorous and Sulphur and rich in available potash. Organic carbon content was medium and soil reaction was slightly alkaline. The experiment was laid out in split plot design with 12 treatments with four sowing dates *viz*. D_1 (26th MW), D_2 (27th MW), D_3 (28th MW) and D_4 (29th MW), and three varieties *viz*. V_1 (TAU-1), V_2 (AKU-15) and V_3 (Yashoda-58) replicated thrice. Three varieties of black gram namely TAU-1, AKU-15 and Yashoda-58 were sown in four different dates to evaluate the optimum sowing date for *kharif*. black gram. Sowing of black gram was done by manually, keeping 30 cm distance between the rows.

Result and Discussion

Growth Attributes

From the data given in Table no. 1 revealed that Growth attributing characters such as plant height, total number of branches plant^{-1}, dry matter accumulation plant^{-1} and maturity duration was significantly influenced by sowing during 26th MW and variety TAU-1. Maximum plant height at harvest was obtained on sowing during 26th MW (66.62 cm) and variety TAU-1 (66 cm) over the 28th MW (63.22 cm) and 29th MW (62.11) and variety Yashoda-58 (62.46) and it was at par with 27th MW (65.56 cm) and variety AKU-15 (64.68 cm).

It is also revealed that total number of branches plant^{-1} (9.16), dry matter accumulation plant^{-1} (12.49) and maturity duration (77.72) was significantly influenced by sowing during 26th MW. This might be due to congenial climatic condition for better germination and further growth and development of *kharif* black gram. These results are in conformity with the findings of Malik *et al.* (2006) [3] and Singh and Kumar (2014) [6]. Among the varieties, TAU-1 produced significantly maximum number of branches plant^{-1} (8.77), dry matter accumulation plant^{-1} (11.65) and maturity duration (78.88). It might be due to meteorological condition at that time and genetic factor of those variety. The results are in accordance with those reported by Patel and Munda (2001) [5] and Kumar *et al.* (2018) [2]. The interaction effect between sowing dates and varieties was found to be non-significant.

Yield attributes and yield

The data given in Table no. 2 revealed that sowing during 26th MW recorded maximum number of pods plant^{-1} (26.44), weight of dry pods plant^{-1} (10.13), grain yield plant^{-1} (7.02) and test weight (42.22 g) were significantly superior over 28th MW and 29th MW, however, it was at par with 27th MW. This might be due to less flower drop and more fruit setting during *kharif* season Similar results were also reported by Ali *et al.* (2014) [1] and Yagoub and Hamed (2013) [11] who inferred these favourable effect of sowing times on grain yield in black gram. Variety TAU-1 recorded maximum number of pods plant^{-1} (25.80), weight of dry pods plant^{-1} (9.47), grain yield plant^{-1} (6.33) and test weight (41.53 g) were significantly superior over Yashoda-58, however, it was at par with AKU-15. This might be attributed due to genetic makeup of cultivar, more number of branches plant^{-1} that helped in production of more number of matured or reproductive pods. These results are close in conformity with Patel and Munda (2001) [5].

The grain yield (9.31 q ha^{-1}), straw yield (13.30 q ha^{-1}) and harvest index (41.17) were significantly highest at sowing during 26th MW over 28th MW and 29th MW, but found at par with 27th MW. This might be due to higher number of pods plant^{-1}, number of seeds plant^{-1}, seed weight plant^{-1} and thousand seed weight. Similar results were also observed by Yadahalli and Palled (2004) [10] and Singh and Kumar (2014) [6]. Among varieties, TAU-1 produced highest grain yield (8.50 q ha^{-1}), straw yield (12.30q ha^{-1}) and harvest index (40.86) were significantly superior over Yashoda-58 and it was at par with AKU-15. This might be due to higher number of pods plant^{-1}, number of seeds plant^{-1}, seed weight plant^{-1}. This is confirmation with the results of Tekale *et* al. (2011) [7] and Singh and Kumar (2014) [6]. Interaction effect between sowing dates and varieties was found to be non-significant.

Table 1: Growth and growth attributes of black gram influenced by various treatments

Sr. No.	Treatments	Plant height (cm)	Total number of branches plant^{-1}	Dry matter accumulation plant^{-1}	Maturity duration (days)
A	**Sowing dates**				
	D_1 – 26th MW	66.62	9.16	12.49	77.72
	D_2 – 27th MW	65.56	8.49	11.22	80
	D_3 – 28th MW	63.22	8.07	10.98	81.89
	D_4 – 29th MW	62.11	7.78	10.31	83.72
	S.E. (m) ±	0.42	0.21	0.38	1
	C.D. at 5%	1.47	0.73	1.32	3.4
B	**Varieties**				
	V_1 – TAU-1	66	8.77	11.65	78.88
	V_2 – AKU-15	64.68	8.35	11.37	81.13
	V_3 – Yashoda-58	62.46	8.00	10.73	82.50
	S.E. (m) ±	0.48	0.14	0.10	0.67
	C.D. at	1.35	0.44	0.32	2.01
C	**Interaction**				
	S.E. (m) ±	0.90	0.29	0.21	1.34
	C.D. at 5%	NS	NS	NS	NS
	G. M.	64.37	8.37	11.25	80.83

Table 2: Yield attributes and yield of black gram as influenced by various treatments

Sr. No.	Treatments	Total no of pods plant^{-1}	Weight of dry pods plant^{-1}	Grain yield plant^{-1}	Test weight	Grain yield q ha^{-1}	Straw yield q ha^{-1}	Harvest index (%)
A	**Sowing dates**							
	D_1 – 26th MW	26.44	10.13	7.02	42.22	9.31	13.30	41.17
	D_2 – 27th MW	24.82	9.00	5.96	40.76	7.99	11.97	40.03
	D_3 – 28th MW	24.20	8.38	5.16	39.89	7.27	11.03	39.72
	D_4 – 29th MW	23.62	8.02	4.87	39.27	6.60	10.13	39.45
	S.E. (m) ±	0.52	0.38	0.33	0.52	0.41	0.51	-
	C.D. at 5%	1.80	1.34	1.14	1.81	1.44	1.76	-
B	**Varieties**							
	V_1 – TAU-1	25.80	9.47	6.33	41.53	8.50	12.30	40.86
	V_2 – AKU-15	24.97	8.83	5.85	40.23	7.81	11.70	40.03
	V_3 – Yashoda-58	23.55	8.35	5.07	39.83	7.07	10.83	39.49

	S.E. (m) ±	0.38	0.23	0.21	0.45	0.24	0.38	-
	C.D. at	1.16	0.71	0.62	1.36	0.73	1.14	-
C	**Interaction**							
	S.E. (m) ±	0.77	0.47	0.42	0.90	0.48	0.76	-
	C.D. at 5%	NS	NS	NS	NS	NS	NS	-
	G. M.	24.77	8.88	5.75	40.39	7.79	11.60	40.10

Conclusion

Sowing of black gram during 26th MW and variety TAU-1 recorded significantly high growth attributing characters *viz.* plant height, dry matter accumulation plant^{-1}, number of branches plant^{-1} and maturity duration and the yield attributing characters *viz.* number of pods plant^{-1}, weight of dry pods plant^{-1}, grain yield plant^{-1}, test weight, grain and straw yield plant^{-1} and harvest index.

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