Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(4): 2275-2278
Received: 18-05-2019
Accepted: 20-06-2019

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Effect of different sowing dates on yield and yield attributes of *rabi* blackgram (*Vigna mungo* L.) varieties in scarce rainfall zone of Andhra Pradesh

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Abstract
Field experiments were conducted to evaluate the performance of *rabi* blackgram (*Vigna mungo* L.) under different sowing windows at Agricultural College, Mahanandi of Acharya N.G. Ranga Agricultural University during October 2017 to January 2018. Four blackgram varieties such asTBG-104, LBG-787, GBG-1 and PU-31 were tested under different sowing windows *viz*., Ist fort night of October, II nd fort night of October, Ist fort night November and IInd fort night November to find out the best suited blackgram. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) having sixteen treatments and three replications. Experimental results revealed that variety and dates of sowing had significant impact on yield attributes of the crop. Among the varieties observed PU-31 performed better with highest plant height, dry weight, number of pods per plant, number of seeds per pod, test weight, seed yield, haulm yield and harvest index, while LBG 787 had lesser yield and yield attributes while compared to the other varieties, while these parameters were found highest and lowest on sowing Ist fortnight of October and IInd fortnight of November, respectively. Sowing PU-31 on Ist fort night of October and IInd fort night of November gave the highest seed yield (856.42 kg ha^{-1}) and haulm yield (2473.96 kg ha^{-1}) and the lowest seed yield (740.68 kg ha^{-1}) and haulm yield (1929.99 kg ha^{-1}), respectively. Results suggested that sowing all the four varieties on 1st fort night of October is desirable for higher seed yield under irrigated condition.

Keywords: Blackgram, *Vigna mungo*, yield and blackgram varieties

Introduction
Pulses are integral part of human diet, providing major source of dietary protein, being the cheap source of protein they ensure nutritional security. Pulses also occupy important position in Indian economy next to cereals and oilseeds with an area of 23.5 M ha accounting for 17.15 Mt production with a productivity of 728 kg ha^{-1}.Blackgram is one of the important pulse crop in India cultivated to an extent of 2.346 M ha with a production of 1.959 M t. In Andhra Pradesh, it occupies an area of 0.315 M ha producing 0.298 Mt. The average productivity of blackgram in Andhra Pradesh (946 kg ha^{-1}) is high compared to India's productivity (604 kg ha^{-1}) (India stat, 2015). The population of India is projected to grow from the current 1.21 billion (in 2015) to 1.68 billion by 2030. Accordingly, the projected pulse requirement for the year 2030 would be 32 million tonnes from the present level of 15 million tonnes with necessary growth rate of 4.2 per cent (Purushottam and Singh 2015). In this context, there is an urgent need to increase the production levels of pulses to meet the increasing demand by manipulating the production techniques. Among different management factors, time of sowing will influence the yield and growth of the blackgram to the most, as the date of sowing determine time of flowering and dry matter accumulation, seed set and seed yield.
In review of the above facts studies were carried out to know the effect of different sowing windows on four different blackgram varieties

Materials and Methods
Field experiment was conducted at College Farm, Agricultural College, Mahanandi of Acharya N.G. Ranga Agricultural University, geographically situated at 15^{0}.51' N latitude and 78^{0}.61' E longitude with an altitude of 233.48 meters above the mean sea level in Scarce Rainfall Zone of Andhra Pradesh. According to the Troll's classification, the location of the experimental plots falls under Semi-Arid Tropics (SAT). The soil at the experiment site was sandy loam in texture, medium in organic carbon and nitrogen, high in phosphorus, potassium and sulphur, medium in calcium, low in magnesium and nearly optimum in zinc. Minimum and maximum temperatures varied from 15.4^{0}C to 32.5^{0}C. Four blackgram varieties namelyTBG-104, LBG-787, GBG-1 and PU-31 were selected for the experiment.

The varieties selected were resistant to Yellow mosaic Virus. Varieties thus selected were sown on first and second fortnight of October and November. Experiments were conducted in Randomized Block Design with factorial concept (FRBD) with sixteen treatments and three replications. The recommended dose of fertilizer of N and $P_2O_5$was 20: 40 kg /ha was applied as basal at the time of sowing. The sowing was done with an interrow spacing of 30cm and the seedrate was 25 kg ha^{-1}. Periodical observations on growth parameters, yield and yield attributes were recorded at 30, 60 DAS and at harvest and analysed statistically with OP STAT. Plant height was measured in centimeters from the base of stem to the top most leaf with the help of meter scale. Grain and haulm yield of each plant was weighed and recorded. All the plants from each pot were harvested and left for sun drying. After threshing, grain yield per plant was recorded.

Results and Discussion

Effect of sowing dates on growth parameters

The effect of different sowing dates on plant height was found to be significant and the higher plant height was observed in the crops sown on Ist fort night of October (46.93 cm) as compared to other dates of sowing. Crops sown on second fort night of November had the lowest plant height (33.99 cm). The rate of increase in dry matter accumulation was slow up to 30 days and faster between 30 to 60 DAS. Higher plant height observed in the first fort night of October might be due to early sowing of blackgram during October enhances the accumulation of more photosynthates due to high temperatures occurred than later dates of sowing [2, 3, 4].

Effect of sowing dates on yield and yield attributes

The mean number of pods $plant^{-1}$, seeds pod^{-1}, 1000 seed weight was significantly influenced by dates of sowing. The sowing on Ist fortnight of October recorded significantly higher pods $plant^{-1}$, seeds pod^{-1} and1000 test weight followed by sowing on Ist fortnight of November and IInd fortnight of November. Increase in the test weight of seeds may be attributed to its short vegetative period and, long reproductive and grain filling period resulting in significant increase of the test weight. The mean seed yield (kg ha^{-1}), haulm yield (kg ha^{-1}) and harvest index was significantly influenced by dates of sowing. The sowing of Ist fort night of October recorded significantly higher seed yield (856.42kg ha^{-1}), haulm yield (2473.96 kg ha^{-1}) harvest index (25.33%) followed by sowing at 1st fort night of November (809.40, 2032.25, 21.47) and 2nd fort night of November (740.68, 1929.99, 19.40). Increase in the seed yield may be the result of increased translocation of photosynthates towards grain formation. Moreover early sowing of the crop resulted in higher accumulation of photosynthates due to high temperatures that later dates of sowing. Higher rate of harvest index might be due to accumulation of more dry matter, production efficiency and higher biomass potential. Present findings of our experimental results are in concurrence with [4-9].

Effect of varieties on growth parameters

Among the four varieties PU-31 performed better having greater growth parameters compared to other three varieties. There was significant difference in plant height and dry matter accumulation. It was observed that the plant height of PU-31 was 29.96, 41.65 and 43.85 cm at 30DAS, 60 DAS and at harvest respectively. Following PU-31, GBG-1 performed better with an average plant height of 28.68, 40.84 and 42.89 cm at 30DAS, 60 DAS and at harvest respectively. LBG-787 had recorded the lowest plant height. It was observed that PU-31 had more dry matter accumulation of 572.46, 2355.35 and 40003.74 kg ha^{-1}at 30DAS, 60 DAS and at harvest respectively while LBG-787 had recorded the lowest dry matter accumulation of 531.40, 2212.29 and 3833.01at 30DAS, 60 DAS and at harvest respectively. The highest dry matter was observed with the variety PU-31 at all the growth stages of crop over other dates of sowing and varieties might be attributed to genetic makeup of variety and effective utilization resources such as water, nutrient, light and space in a conductive crop environment. Moreover, during early stages of crop growth the allocation of dry matter was towards to the vegetative plant parts. These results are in concurrence with [10-13]. The interaction between varieties and dates of sowing in dry matter accumulation was found to be non-significant at all stages of (30, 60 DAS and at harvest) of crop growth during experimentation.

Effect of varieties on yield and yield attributes

Among the four varieties tested PU-31 had performed better with greater yield and yield attributes. PU-31 had yielded higher number of pods $plant^{-1}$(23.42) because of its genetic makeup having higher photosynthetic activity resulting in increased source capacity and efficient translocation of photosynthates to the sink. Number of seeds pod^{-1}(5.38) and test weight (23.21g) was also significantly higher in PU-31 with respect to its short vegetative period of growth and comparatively long reproductive and grain filling period that significantly raised the test weight of the variety. These results were in confirmatory with the results of [14-16].

Seed yield of 845.15(kg ha^{-1}), haulm yield of 2286.61(kg ha^{-1}) and harvest index of 23.21 per centwas observed in PU-31 which is also significantly higher when compared to other varieties. Higher seed yield may be due to its inherited genetic makeup results in increased translocation of photosynthates towards grain formation. These results are in line with the findings of [4-6]. The highest haulm yield in PU-31 might be due to accumulation of more dry matter, production efficiency and higher biomass potential. Higher harvest index might be due to increased sink capacity in PU-31. These results were in confirmatory with the results of [17-19].

Table 1: Effect of varieties and dates of sowing on Plant height (cm), Dry matter (kg ha^{-1})

Treatments	Plant height (cm)			Dry Weight (kg ha^{-1})		
	30DAS	60DAS	At harvest	30DAS	60DAS	At harvest
Varieties						
V_1: TBG-104	28.6	39.45	42.18	534.54	2281.94	3912.30
V_2: LBG-787	27.86	39.04	41.34	531.40	2212.29	3833.01
V_3: GBG-1	28.68	40.84	42.89	548.96	2322.79	3952.96
V_4: PU-31	29.96	41.65	43.85	572.46	2355.35	4003.74
Sem+_	0.42S	0.53S	0.48S	6.96S	25.42S	41.48S
CD (P= 0.05%)	1.21S	1.53S	1.37S	20.09S	73.39S	119.78S

Dates of sowing						
D_1: 1st FN of October	32.76	45.17	46.93	687.27	2509.84	4546.46
D_2: 2nd FN of October	29.93	43.51	45.12	596.04	2374.13	4392.18
D_3: 1st FN of November	27.45	40.18	44.22	500.39	2233.07	3651.81
D_4: 2nd FN of November	24.73	32.09	33.99	409.67	2054.74	3111.56
Sem+_	0.42S	0.53S	0.48S	6.96S	25.42S	41.48S
CD (P= 0.05)	1.21S	1.53S	1.37S	20.09S	73.39S	119.78S
Interaction (VXD)						
Sem+_	0.84NS	1.06NS	0.95NS	13.91NS	50.83NS	82.97NS
CD vaule (P=0.05)	2.42NS	3.06NS	2.75NS	40.18NS	146.77NS	239.56NS

Table 2: Effect of varieties and dates of sowing on No. of pods plant^{-1}, No. of seeds pod^{-1}, 1000 test weight, Seed yield (kg ha^{-1}), Haulm yield (kg ha^{-1}), Harvest index (%)

Treatments	**No. of pods plant^{-1}**	**No of seeds pod^{-1}**	**1000 test weight (g)**	**Seed yield (kg ha^{-1})**	**Haulm yield (kg ha^{-1})**	**Harvest index (%)**
Varieties						
V_1: TBG-104	21.88	4.88	39.85	789.55	2093.39	22.70
V_2: LBG-787	21.62	4.79	39.08	778.13	2020.77	20.02
V_3: GBG-1	22.97	5.15	40.80	828.76	2247.76	23.12
V_4: PU-31	23.42	5.38	41.36	845.15	2286.61	23.21
Sem+_	0.95NS	0.27NS	0.51S	3.58S	41.27S	0.44S
CD (P= 0.05%)	2.73NS	0.77NS	1.48S	10.32S	119.15S	1.27S
Dates of sowing						
D_1: 1st FN of October	25.70	7.48	42.45	856.42	2473.96	25.33
D_2: 2nd FN of October	22.88	6.54	40.75	835.10	2212.34	22.85
D_3: 1st FN of November	21.42	6.17	39.53	809.40	2032.25	21.47
D_4: 2nd FN of November	19.89	5.29	38.36	740.68	1929.99	19.40
Sem+_	0.95S	0.27S	0.51S	3.58S	41.27S	0.44S
CD (P= 0.05)	2.73S	0.77S	1.48S	10.32S	119.15S	1.27S
Interaction (VXD)						
Sem+_	1.89NS	0.53NS	1.02NS	7.15S	82.53NS	0.88NS
CD (P= 0.05)	5.46NS	1.54NS	2.95NS	20.65S	238.31NS	2.53NS

Conclusion

Ist FN of October seems to be the appropriate sowing date for getting higher seed yields of blackgram crop during *rabi* season. Among different varieties PU-31 came out to be higher yielder which was followed by GBG-1, TBG-104 and LBG-787.

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