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Effect on Summer Black Gram (*Phaseolus mungo* L.) to different Sowing Time and Weed Management Practices with Respect to Yield, Quality and Nutrient Uptake

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Abstract: *An experiment was carried out on "Response of summer blackgram (*Phaseolus mungo *L.) to different sowing time and weed management practices" at AICRP on Irrigation Water Management, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during summer season, 2015 The experiment was laid out in a factorial randomized block design with three replications. Eighteen treatment combinations consisting of three levels of sowing times and six levels of weed management practices. The predominant weed flora observed in the experimental plot were* Cynodon dactylon, Cyperus rotundus, Digera arvensis, Parthenium hysterophorus, Euphorbia geneculata, Euphorbia thymifolia *and* Portulaca oleracea. *Total weed count and weed dry matter was higher under 3rd week of March sowing and in weedy check. Weed control efficiency was recorded highest under 1st week of March sowing and in treatment one hoeing at 20 DAS & one hand weeding at 40 DAS. Weed index was recorded the highest under 3rd week of March sowing and in treatment weedy check. Sowing on 1st week of March (D_2) recorded significantly the highest seed (11.04 q ha^{-1}) and stover yields (14.40 q ha^{-1}) of summer blackgram. Likewise weed free up to harvest treatment gave significantly highest seed (12.19 q ha^{-1}) and stover yields (15.98 q ha^{-1}) and was at par with one hoeing at 20 DAS* fb *one hand weeding at 40 DAS and Pendimethalin @ 1 kg a.i. ha^{-1} (PE) fb imazethapyr @ 75 g a.i. ha^{-1} (PoE) at 20 DAS. Significantly the highest protein content in seed was found in weed free up to harvest but it was at par with treatments one hoeing at 20 DAS* fb *one hand weeding at 40 DAS and pendimethalin @ 1 kg ha^{-1} (PE)* fb *imazethapyr @ 75 g ha^{-1}. Magnitude of N, P and K uptake in seed and stover was significantly maximum in 1st week of March sowing while uptake of nutrients by weeds was minimum in weed free up to harvest.*

Keywords: *Blackgram, imazethapyr, pendimethalin, weed control efficiency, yield and nutrient uptake*

INTRODUCTION

Blackgram is an important pulse crops in intensive cropping system of India due to its short growing duration but the average yield of blackgram is very low. In India, black gram is mostly grown on area of about 3.5 million ha with a total production of 1.5 to 1.9 million tonnes with an average productivity of 500 kg ha^{-1} In Maharashtra, the area and production of this crop is about 5.75 lakh hectares and 3.27 lakh tonnes, respectively with productivity of 568.7 kg ha^{-1} in the state (Anonymous 2015).

Besides growing of this crop on marginal land, heavy weed infestation is the dominant reason for such a low yield of black gram. In general, yield loss due to uncontrolled weed growth in black gram ranges from 27 to 100%. Blackgram is less competitive against many weeds during early stage of crop and the most sensitive period of weed competition is between 15 to 45 days after sowing. Various methods like cultural, mechanical, biological and chemicals are used for weed control (Fand *et al.*, 2013).

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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 phonological development in crops and to predict maturity dates (Major *et al*. 1975). Planting the crop at optimum time therefore, plays a key role in obtaining high seed yields (Ihsanullah et al. 2002 and Dubey and Singh, 2006).

For summer black gram, germination is affected due to low temperature if sowing is done early and if the crop is sown late, there are chances of damage from rain. It is, therefore, necessary to find out optimum period of sowing for black gram in summer season for obtaining higher production. Similarly among several factors responsible for low yields of pulse crops in India, weed infestation is considered one of the major factors. Black gram often suffers severe weed competition especially during early growth phases. Being a short duration and initially slow growing, black gram is heavily infested with narrow and broad leaved weeds and sedges which compete with crops, resulting in yield reduction to the tune of 30-50 per cent (Mishra, 1997). It needs more attention to control weeds during summer as it grows more vigorously due to more sunshine and irrigation (Jain and Jain, 1997). Keeping aforesaid points in view, the present investigation entitled, "Response of summer black gram (*Phaseolus mungo* L.) to different sowing time and weed management practices" was planned during summer.

MATERIALS AND METHODS

The experiment was carried out at Irrigation Water Management Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during summer 2015. Treatments comprised of eighteen treatment combinations consisting of three levels of sowing times *viz*. 3rd week of Feb. (16th February), 1st week of March (2nd March) and 3rd week of March (17th March) in combination with six levels of weed management practices *viz*. weedy check (control), weed free up to harvest, pendimethalin @ 1 kg ha^{-1} (PE), pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} (PoE) at 20 DAS, imazethapyr @ 75 g ha^{-1} (PoE) at 20 DAS and one hoeing at 20 DAS *fb* one hand weeding at 40 DAS was replicated three times in factorial randomized block design keeping individual plot size of 4 m x 3.6 m. Soil of the experimental field was clayey in texture and low in organic carbon (0.68 %), available nitrogen (150.50 kg ha^{-1}), medium in available phosphorus (15.15 kg ha^{-1}) and high in available potassium (358 kg ha^{-1}) with slightly alkaline (pH 7.81) in reaction. Blackgram variety TAU 1 was sown at 30 cm × 10 cm spacing using a seed rate of 12 kg ha^{-1} and post emergence application done at 20 days after sowing. The sowing was done at per treatment on 16th February, 2nd March and 17th March. A recommended dose of fertilizer was 20: 40: 0 kg N, P_2O_5 and K_2O ha^{-1}, respectively which was given as basal. Other recommended package of practices except weed management was adopted to grow the experimental crop. A knapsack sprayer fitted with flat-fan nozzle used to apply the herbicides on the first day after sowing as pre emergence and 20 DAS as post emergence application with spray volume of 500 liters ha^{-1}. Weed count data were recorded from 1 m^{-2} area randomly in each plot. Observations on growth parameters were also recorded. Data on seed yield along with yield attributes were recorded at harvest. The weed count and weed dry matter were subjected to square root transformation *"(X+0.5)* to normalize the distribution.

RESULT AND DISCUSSION

Weed flora

The experimental field was dominated by dicot weeds than monocot and sedges in each treatment. The major dicot weeds observed were *Digera arvensis, Parthenium hysterophorus, Euphorbia geneculata, Euphorbia thymifolia, Portulaca oleracea* but most dominating weeds were *Parthenium hysterophorus, Euphorbia geneculata* at all stage of crop growth.

Effect of sowing time

The growth parameters viz., plant height, number of branches plant^{-1}, number of root nodules plant^{-1}, number of leaves plant^{-1}, leaf area plant^{-1} and dry matter accumulation (g plant^{-1}) at harvest were significantly affected by sowing time. Sowing on 1st week of March recorded appreciably or significantly higher values of almost all the growth parameters. However, it was statistically identical with first sowing time 3rd week of February (16th February). Significantly the lowest values were recorded under third sowing time 3rd week of March (17th March) in all of the growth attributing characters. Sowing on 3rd week of February took significantly the maximum days to 50 per cent flowering but it was at par with 1st week of March. Whereas, the least number of days to 50 per cent flowering were recorded in 3rd week of March. Yield attributing characters *viz*., number of pods plant^{-1} were significantly influenced by different sowing time treatments while other characters like number of seeds pod^{-1}, pod length and 100 seed weight showed non-significant influence. Significantly higher numbers of pods plant^{-1} were recorded under 2nd March sowing which were statistically at par with 16th February sowing. Significantly the lowest number of pods plant^{-1} was recorded under 17th March sowing. Different sowing times showed significant effect on the seed yield. Significantly maximum seed yield (11.04 q ha^{-1}) was recorded in treatment 1st week of March sowing but found at par with treatment 16th February sowing. Significantly the lowest seed yield production was produced under the treatment 3rd week of March sowing. Higher yield during 1st week of March sowing was mainly owing to favorable temperatures and humidity during their growth period and better nodulation resulting in better growh. The results confirm the findings of Gupta and Lal (1989), Panwar and Sharma (2004), Kumar *et al.* (2008) and Gangwar *et al.* (2013).

Effect of weed management

There was significant impact on weed population and dry weight of total weeds by weed management practices. Significantly lower weed population at 14 DAS was observed in pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} (PoE) at 20 DAS followed by pendimethalin @ 1 kg ha^{-1} (PE). However at 28, 42, 56 DAS and at harvest significantly lower weed population observed in one hoeing at 20 DAS & one hand weeding at 40 DAS followed by pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} (PoE) at 20 DAS. So far dry weight of weeds at harvest is concerned, all the treatments of weed management differed significantly from each other and remained in $W_6<W_4<W_3<W_5<W_1$ order of their significance. Weed free up to harvest, one hoeing at 20 DAS & one hand weeding at 40 DAS and pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} (PoE) at 20 DAS had significantly influenced most of the growth attributes of blackgram and recorded higher values for plant height, number of branches plant^{-1}, number of leaves plant^{-1}, leaf area plant^{-1} and dry matter production plant^{-1} recorded and found superior to rest of the weed management practices. Treatment of weed free up to harvest recorded significantly higher number of pods plant^{-1} and pod length and it was at par with one hoeing at 20 DAS & one hand weeding at 40 DAS and pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} (PoE) at 20 DAS. However, effect of weed management practices on number of seeds pod^{-1} and 100 seed weight was found non-significant. The seed yield (q ha^{-1}) differed significantly due to different weed management practices. The highest (12.19 q ha^{-1}) seed yield was recorded by the treatment weed free up to harvest but it was at par with treatments one hoeing at 20 DAS & one hand weeding at 40 DAS and pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} at 20-25 DAS. The lowest seed yield of blackgram was found in the treatment comprising weedy check.

Effect on quality

The results revealed that the differences in various treatments of sowing time was found non-significant with respect to protein content in seed. However, numerically higher protein content was recorded in treatment 1st week of March sowing. The weed management practices had significant effect on protein content in seeds. Significantly the highest protein content in seed was found in weed free up to harvest but it was at par with treatments one

hoeing at 20 DAS *fb* one hand weeding at 40 DAS and pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} at 20-25 DAS. Weedy check registered the lowest protein content in seed. This might be due to effective weed control methods which was controlled weeds effectively resulting in the significant reduction in crop-weed competition which benefited the crop with more nutrients and water, which reflects in higher nitrogen content as well as protein content in seeds.

Significantly the highest protein yield was recorded under crop sown on 1st week of March which was statistically at par with treatment 3rd week of February sowing and the lowest protein yield in 3rd week of March. These results are in accordance with the findings of Tekale (2010) and partially agreement with the findings of Gangwar *et al.* (2013). The highest protein yield was recorded under weed free up to harvest and at par with one hoeing at 20 DAS *fb* one hand weeding at 40 DAS and pendimethalin @ 1 kg ha^{-1} (PE) *fb* imazethapyr @ 75 g ha^{-1} at 20-25 DAS. The lowest protein yield was found under treatment weedy check. The increase in protein yield might be due to higher protein content in black gram seed and higher seed yield under effective weed management treatments. Similar results were also reported by Singh ***et al.*** (1999) for mung bean.

Nutrient uptake by crop

Data pertaining the mean nutrient uptake by seed and stover of black gram crop (kg ha^{-1}) as influenced by different treatments at various crop growth stages are presented in Table 4. The difference in the uptake of N, P and K in seed and stover due to different sowing time treatments were statistically significant and magnitude of N, P and K uptake (kg ha^{-1}) in seed and stover was significantly maximum in treatment D_2 (1st week of March sowing) but found at par with treatment D_1 (16th February sowing). Significantly the minimum uptake was found under the treatment D_3 (3rd week of March sowing). This increased uptake by seed and stover might be due to increased yield of seed and stover under treatment D_2. Similar results were also observed by Ram and Dixit (2000) and Tekale (2010).

The uptake of N, P and K in seed and stover due to different weed management practices treatments were statistically significant and magnitude of N, P and K uptake (kg ha^{-1}) in seed and stover was significantly maximum in treatment weed free up to harvest (W_2) and at par with one hoeing at 20 DAS *fb* one hand weeding at 40 DAS (W_6) and pendimethalin @ 1 kg a.i. ha^{-1} (PE) *fb* imazethapyr @ 75 g a.i. ha-*1* at 20-25 DAS (W_4) in case of uptake of N and P by seed otherwise it was at par with only W_6. The lowest uptake of N, P and K in seed and stover of black gram was found in the treatment comprising weedy check (W_1). The increasing in yield and nutrient uptake under these treatments W_2, W_4 and W_6 might be attributed to significant reduction in weed dry matter, there by reduction in crop weed competition which provided congenial environment to the crop for better expression of vegetative and reproductive potential. The lower uptake of nutrients in weedy check (W_1) could be accounted with the fact that, weeds not only deprive the crop of the valuable nutrients but they also compete with crops for light, moisture and space causing physical impedance both with regard to aerial and subterranean environments. The results are in agreement with the findings of Modak *et al.* (1995), Choubey *et al.* (1999) for black gram and Kaur *et al.* (2010) for mungbean.

Nutrient uptake by weed

Significantly highest N, P and K uptake by weeds was found under treatment D_3 (3rd week of March sowing) because of higher weed dry matter production. The lowest N, P and K uptake by weeds was observed in treatment D_2 (1st week of March sowing) but which was at par with D_1 (16th February sowing) in uptake of N and P. However, this might be due to higher weed biomass produced in D_3 due to comparatively better availability of nutrients, space, temperature and light for weed ultimately resulted into significantly higher N, P and K uptake with these treatments.

In case of weed management practices, significantly the highest N, P and K uptake by weeds was found under weedy check (W_1) because of higher weed dry matter production. The lowest N, P and K uptake by weed was observed in treatment

weed free up to harvest (W_2) which was followed by one hoeing at 20 DAS *fb* one hand weeding at 40 DAS (W_6) and pendimethalin @ 1 kg a.i. ha^{-1} (PE) *fb* imazethapyr @ 75 g a.i. ha^{-1} at 20-25 DAS (W_4).

The results clearly indicated that whatever weeds survived were not equally competitive for absorption of nutrients from the soil. This might be due to the vigorous growth of weeds and the highest weed biomass production under this treatment. The results are in agreement with the findings of Tewari *et al.* (1990), Chin and Pandey (1991), Choubey *et al.* (1999) for black gram and Kaur *et al.* (2010) for mungbean.

Table 1

Effect of different sowing time and weed management practices on weed count, dry weight of weed, weed control efficiency and weed index of weeds at harvest

Treatment	*Total Weed density (no. of m^2)*	*Dry weight of weed (g m^2)*	*Weed control efficiency (%)*	*Weed Index*
Sowing time (D)				
D_1 : 3rd week of Feb. (16th Feb.)	4.51 (24.98)	5.68 (39.33)*	58.66	29.52
D_2 : 1st week of March (2nd March)	4.16 (21.37)	5.43 (36.13)	60.17	23.52
D_3 : 3rd week of March (17th March)	4.82 (28.53)	5.83 (41.40)	58.28	37.00
S.Em.±	0.05	0.06	0.86	4.59
CD at 5%	0.15	0.17	NS	NS
Weed management (W)				
W_1: Weedy check (control)	7.83 (60.98)	9.96 (98.87)	0.00	74.43
W_2 : Weed free up to harvest	0.71 (0.00)	0.71 (0.00)	100.00	0.00
W_3 : Pendimethalin @ 1 kg a.i. ha^{-1} (PE)	5.26 (27.31)	6.16 (37.56)	55.03	35.24
W_4 : Pendimethalin @ 1 kg a.i. ha^{-1} (PE) *fb* imazethapyr @ 75 g a.i. ha^{-1} (PoE) at 20 DAS	4.64 (21.20)	5.56 (30.47)	65.31	15.92
W_5: Imazethapyr @ 75 g a.i. ha^{-1} (PoE) at 20 DAS	5.78 (33.09)	6.69 (44.27)	45.56	45.67
W_6 : One hoeing at 20 DAS *fb* one hand weeding at 40 DAS	2.76 (7.20)	4.79 (22.57)	88.32	8.84
SEm±	0.07	0.08	1.21	6.49
CD at 5%	0.21	0.23	3.49	18.65

Table 2

Effect of different sowing time and weed management practices on yield attributes and yield of blackgram

Treatments	*Number of pods plant^{-1}*	*Number of seeds pods^{-1}*	*Pod length (cm)*	*100 seed weight (g)*	*Seed yield (q ha^{-1})*	*Stover yield (q ha^{-1})*	*Harvest index (%)*
Sowing time (D)							
D_1 : 3rd week of Feb. (16th Feb.)	20.47	6.40	5.39	4.99	10.46	13.91	42.75
D_2 : 1st week of March (2nd March)	21.14	6.46	5.40	5.07	11.04	14.40	43.24
D_3 : 3rd week of March (17th March)	18.78	6.38	5.23	4.93	8.99	12.88	41.03

(*contd... Table 2*)

Treatments	*Number of pods plant^{-1}*	*Number of seeds pods^{-1}*	*Pod length (cm)*	*100 seed weight (g)*	*Seed yield (q ha^{-1})*	*Stover yield (q ha^{-1})*	*Harvest index (%)*
S. Em.±	0.39	0.14	0.12	0.11	0.28	0.34	1.01
CD at 5%	1.12	NS	NS	NS	0.80	0.96	NS
Weed management (W)							
W_1: Weedy check (control)	17.38	5.99	4.78	4.88	7.32	10.77	40.78
W_2 : Weed free up to harvest	21.65	6.69	5.83	5.14	12.19	15.98	43.21
W_3 : Pendimethalin @ 1 kg a.i. ha^{-1} (PE)	20.01	6.44	5.08	4.96	9.47	13.09	41.78
W_4 : Pendimethalin @ 1 kg a.i. ha^{-1} (PE) *fb* imazethapyr @ 75 g a.i. ha^{-1} (PoE) at 20 DAS	20.81	6.54	5.70	5.00	11.52	14.75	43.86
W_5: Imazethapyr @ 75 g a.i. ha^{-1} (PoE) at 20 DAS	19.62	6.20	4.87	4.95	8.79	12.36	41.36
W_6 : One hoeing at 20 DAS *fb* one hand weeding at 40 DAS	21.34	6.60	5.77	5.04	11.70	15.44	43.06
S. Em.±	0.55	0.20	0.17	0.16	0.40	0.47	1.43
CD at 5%	1.59	NS	0.49	NS	1.14	1.36	NS

Table 3

Total nutrient uptake by weed, grain and black gram crop as influenced by sowing time and weed management practices

Treatments	*Total nutrition uptake by weed (kg ha^{-1})*			*Total nutrition uptake by weed (kg ha^{-1})*			*Total nutrition uptake by weed (kg ha^{-1})*		
	N	*P*	*K*	*N*	*P*	*K*	*N*	*P*	*K*
Sowing time (D)									
D_1 : 3rd week of Feb. (16th Feb.)	6.24	1.86	5.83	39.84	3.73	8.57	18.29	3.00	13.26
D_2 : 1st week of March (2nd March)	5.66	1.72	5.37	42.23	4.17	9.04	19.67	3.21	14.05
D_3 : 3rd week of March(17th March)	6.89	1.99	6.17	33.82	3.34	7.21	16.59	2.71	11.59
SEm±	0.27	0.06	0.16	1.32	0.16	0.29	0.53	0.10	0.43
CD at 5%	0.77	0.18	0.45	3.80	0.45	0.84	1.52	0.29	1.23
Weed management (W)									
W_1 : Weedy check (control)	18.20	5.37	15.50	26.20	2.02	5.15	11.70	1.79	7.64
W_2 : Weed free up to harvest	0.00	0.00	0.00	48.01	5.16	10.83	23.79	3.96	17.29
W_3 : Pendimethalin @ 1 kg a.i. ha^{-1} (PE)	5.57	1.63	5.33	34.59	3.33	7.42	15.38	2.74	11.51
W_4: Pendimethalin @ 1 kg a.i. ha^{-1} (PE) *fb* imazethapyr @ 75 g a.i. ha^{-1} (PoE) at 20 DAS	4.01	1.14	4.27	45.07	4.53	9.57	21.38	3.22	14.98
W_5 : Imazethapyr @ 75 g a.i. ha^{-1} (PoE) at 20 DAS	7.03	2.23	6.54	32.08	2.72	6.60	14.10	2.41	10.13
W_6 : One hoeing at 20 DAS *fb* one hand weeding at 40 DAS	2.78	0.76	3.09	45.84	4.71	10.05	22.74	3.71	16.26
SEm±	0.38	0.09	0.22	1.87	0.22	0.41	0.75	0.14	0.61
CD at 5%	1.09	0.26	0.63	5.37	0.63	1.19	2.15	0.40	1.75

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