

Original Research Article

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## Effects of Irrigation and Foliar Nutrition on Growth, Yield and Nutrient Uptake of Blackgram (*Vigna mungo* L.)

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### ABSTRACT

#### Keywords

Blackgram, Foliar nutrition, Growth, Irrigation, Nutrient uptake, Yield

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A field experiment was conducted on sandy loam soils of Agricultural Research Station, Jangamaheswarapuram during *rabi*, 2016-17 to study the effect of irrigation and foliar nutrition on growth, yield and nutrient uptake of blackgram. The experiment was laid out in split plot design and replicated thrice. The treatments comprised of four main plots *viz.*, No irrigation (I<sub>1</sub>), Irrigation at 0.3 IW/CPE (I<sub>2</sub>), 0.4 IW/CPE (I<sub>3</sub>) and 0.5 IW/CPE (I<sub>4</sub>) ratios and four sub plot treatments *viz.*, foliar spraying of 2% urea (F<sub>1</sub>), 2% DAP (F<sub>2</sub>), 1% KNO<sub>3</sub> (F<sub>3</sub>) and 2% 19-19-19 (F<sub>4</sub>) twice at pre-flowering pod filling stages. Among the main plot treatments, irrigation given at vegetative stage (33 DAS) i.e. 0.5 IW/CPE ratio was found to be better in improving growth, yield parameters and more nutrient uptake over other irrigation treatments. Among, sub plot treatments 1% KNO<sub>3</sub> twice at pre-flowering and pod filling stages (F<sub>3</sub>) recorded significantly the highest growth and yield of blackgram when compared with other foliar treatments.

### Introduction

Pulses are wonderful gift of nature with unique ability of biological nitrogen fixation, deep root system, mobilization of insoluble soil nutrients and bringing qualitative changes in soil properties. Blackgram (*Vigna mungo* L.), also known as urd bean, mash and black maple is a short duration pulse crop grown in many parts of India. It is one of the highly prized pulse crops with regard to its antiquity and its use as a source of human food. Blackgram seed contains 25-26 % proteins, 60 % carbohydrates, 1.5 % fat and minerals

combination, aminoacids and essential vitamins. India is the largest producer as well as consumer of blackgram which accounts for about 10 per cent of India's total pulse production. The World Health Organization recommended as per capita consumption of pulses at 80 g day<sup>-1</sup>. But at present the per capita availability of pulses is only 40 g day<sup>-1</sup> in India. In Andhra Pradesh, blackgram is grown in an area of 3.17 lakh ha with a production of 2.16 lakh tonnes and productivity of 866 kg ha<sup>-1</sup> during the year 2015-16 (Agriculture action plan 2015-16, Department of Agriculture, A.P). Rice -

blackgram cropping system is famous in Guntur District of Andhra Pradesh. In *khariif*, it is grown in 0.19 lakh ha, producing 0.21 lakh tonnes with a productivity of 1079 kg ha<sup>-1</sup>. In *rabi*, it occupies 2.98 lakh ha, producing 1.95 lakh tonnes with a productivity of 653 kg ha<sup>-1</sup> (Department of Agriculture and Co-operation, Government of Andhra Pradesh. 2015).

Therefore, present research is carried out to improve the productivity of blackgram through irrigation and foliar nutrition with chemicals like 2% urea, 2% DAP, 2% KNO<sub>3</sub> and 2% 19-19-19 in order to enhance the productivity by improving growth and yield parameters of blackgram.

### Materials and Methods

In present study, seed of PU-31 variety was used. The experiment was conducted on sandy loam soils of Agricultural Research Station, Jangamaheswarapuram during *rabi*, 2016-17 to study the Effect of irrigation and foliar nutrition on growth, yield and nutrient uptake of blackgram (*Vigna mungo* L.).

The experiment was laid out in split plot design and replicated thrice with four irrigation levels *viz.*, I<sub>1</sub> - Control, I<sub>2</sub> -Irrigation at 0.3 IW/CPE, I<sub>3</sub> - Irrigation at 0.4 IW/CPE and I<sub>4</sub> - Irrigation at 0.5 IW/CPE ratios as main plots and four foliar spray treatments F<sub>1</sub> – 2 % urea, F<sub>2</sub> – 2 % DAP, F<sub>3</sub> – 1 % KNO<sub>3</sub> and F<sub>4</sub> – 2 % 19-19-19 applied twice at pre flowering and pod filling stages as sub plots.

The soil of the experimental area was sandy loam with p<sup>H</sup> 8.51, low in organic carbon (0.38 %) and available nitrogen (140 kg ha<sup>-1</sup>), high in phosphorus (54 kg ha<sup>-1</sup>) and potassium (436 kg ha<sup>-1</sup>). Recommended dose of fertilizer @ 20 kg N ha<sup>-1</sup> and 50 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> was applied uniformly to all the experimental plots at the time of sowing as basal.

## Results and Discussion

### Growth

Plant height of blackgram was found to be non-significant with respect of irrigation levels and foliar nutrition treatments. The highest plant height was recorded with irrigation at 0.5 IW/CPE (15.7, 19.9, 28.3, 33.1 and 34.1 cm) followed by irrigation at 0.4 IW/CPE and 0.3 IW/CPE ratios and the lowest plant height was recorded in control plot (14.1, 18.4, 25.4, 29.6 and 30.6 cm) at 15, 30, 45, 60 and 75 DAS.. The influence of irrigation and foliar nutrition on number of branches plant<sup>-1</sup> was found to be significant at 45, 60 and 75 DAS except at 30 DAS. The highest number of branches plant<sup>-1</sup> was recorded at 0.5 IW/CPE (4.4, 6.2, 6.4 and 6.9) at all the growth stages but at 30 DAS the difference was found to be non-significant. The influence of foliar nutrition on plant height of blackgram was found to be non-significant at all the growth stages of crop. The highest plant height of 15.3, 19.4, 27.3, 31.8 and 32.8 cm was recorded with foliar spray of 1 % KNO<sub>3</sub>. A significant influence of foliar nutrition on number of branches plant<sup>-1</sup> was observed at 45, 60 and 75 DAS but not at 30 DAS. Foliar application of 1 % KNO<sub>3</sub> recorded significantly the highest number of branches plant<sup>-1</sup> (4.2, 6.2, 6.5 and 7.0) at 30, 45, 60 and 75 DAS. At 45 DAS 1 % KNO<sub>3</sub> recorded the highest number of branches plant<sup>-1</sup> but was on a par with 2 % DAP and 2 % 19-19-19. The lowest number of branches plant<sup>-1</sup> was recorded with 2 % urea at all the growth stages. The increase in plant height and more number of branches is due to the additional supply of nutrients through foliar application which might have increased nutrient uptake and better translocation of nutrients. Similar results were reported by Subramani and Solaimalai (2000) and Parasuraman (2001). The dry matter production at various growth stages clearly indicated that there is a gradual

increase in dry matter production with duration of the crop. At all the stages of crop growth the highest dry matter production was recorded at 0.5 IW/CPE ratio (218, 576, 857, 3322 and 3793 kg ha<sup>-1</sup>) which was significantly superior to all other irrigation treatments. The influence of foliar nutrition on dry matter production of blackgram was found to be significant at all the growth stages of the crop. Foliar spraying of 1 % KNO<sub>3</sub> recorded the maximum dry matter production (192, 488, 837, 2735 and 3206 kg ha<sup>-1</sup>). At 75 DAS, foliar spray with 1 % KNO<sub>3</sub> was comparable with 2 % DAP and 2 % 19-19-19. The interaction effect of irrigation levels and foliar nutrition on dry matter production was found to be non-significant at all the stages of crop growth. Increased dry matter production in leaf, stem, reproductive parts and total dry matter at harvest was mainly due to additional foliar application of water soluble fertilizers which led to increased uptake of nutrients which in turn helped in increased plant height and number of branches. This contributed for better plant growth and ultimately increased the dry matter production. These results are in confirmation with the findings of Thiyageswari and Ranganathan (1999), Anbumani *et al.*, (2003). These results are in confirmation with the results of Jayarami Reddy *et al.*, (2004).

## **Yield**

The data recorded on yield attributes indicated that the influence of irrigation and foliar nutrition treatments on number of clusters plant<sup>-1</sup> and test weight was found to be significant. But the significant difference in yield attributes such as number of pods cluster<sup>-1</sup> and seeds pod<sup>-1</sup> were not noticed. The maximum number of yield attributes such as number of clusters plant<sup>-1</sup>, pods cluster<sup>-1</sup> and seeds pod<sup>-1</sup> was recorded in 0.5 IW/CPE (3.8, 6.2 and 6.3) and minimum were recorded in no irrigated treatment (2.9, 5.9 and 6.0). Among foliar treatments, 1 % KNO<sub>3</sub> recorded

maximum yield attributing parameters like as number of clusters plant<sup>-1</sup>, pods cluster<sup>-1</sup> and seeds pod<sup>-1</sup> (3.7, 6.1 and 6.3). The interaction effect of irrigation and foliar nutrition on test weight of blackgram was found to be significant. Significantly the highest mean maximum test weight was recorded with I<sub>4</sub>F<sub>3</sub> (Irrigation at 0.5 IW/CPE along with 1 % KNO<sub>3</sub>) (50.2 g) and was on a par with I<sub>4</sub>F<sub>2</sub> (49.2 g) and the lowest mean maximum test weight was recorded with I<sub>1</sub>F<sub>1</sub> (No irrigation plot along with 2 % urea) treatment (36.2 g). On the contrary, the lowest test weight with lower irrigation frequency might be due to the effect of soil moisture stress leading to poor translocation of photosynthates resulting in shrivelled and small sized seeds. Similar findings were reported by Dabhi *et al.*, (1998) and Mustafa *et al.*, (2008).

The highest seed yield was recorded in 0.5 IW/CPE (959 kg ha<sup>-1</sup>) and it was significantly superior to all other irrigation treatments. With respect to haulm yield the highest haulm yield was recorded with 0.5 IW/CPE (1935 kg ha<sup>-1</sup>) which was comparable with irrigation at 0.4 IW/CPE (1750 kg ha<sup>-1</sup>). The lowest seed and haulm yield were recorded in no irrigated plot (610 and 1356 kg ha<sup>-1</sup>). Foliar spraying of 1 % KNO<sub>3</sub> twice at pre-flowering and pod filling stages recorded the highest seed yield (833 kg ha<sup>-1</sup>) which was on a par with 2 % DAP (782 kg ha<sup>-1</sup>) and the lowest seed yield was recorded with 2 % urea (704 kg ha<sup>-1</sup>) but on a par with 2 % 19-19-19 (749 kg ha<sup>-1</sup>). The highest haulm yield was recorded with 1 % KNO<sub>3</sub> (1828 kg ha<sup>-1</sup>) which was significantly superior to all other foliar treatments. The influence of irrigation and foliar nutrition on harvest index of blackgram was found to be non-significant. The interaction effect of irrigation levels and foliar nutrition on yield attributes, yield and harvest index of blackgram was found to be non-significant. These results are also in conformity with the findings of Krishnamurthy and Ramulu (2007), Beg *et al.*, (2013) and Kadam *et al.*, (2008).

**Table.1** Effect of irrigation and foliar nutrition on growth parameters of blackgram at harvest

Treatment		Growth parameters at harvest		
		Plant height (cm)	No.of branches plant <sup>-1</sup>	Dry matter production (kg ha <sup>-1</sup> )
<i>Irrigation levels</i>				
<b>I<sub>1</sub></b>	Control	30.6	6.1	2414
<b>I<sub>2</sub></b>	0.3 IW/CPE ratio	31.7	6.5	2656
<b>I<sub>3</sub></b>	0.4 IW/CPE ratio	32.1	6.7	3353
<b>I<sub>4</sub></b>	0.5 IW/CPE ratio	34.1	6.9	3793
	<b>SEm ±</b>	<b>1.11</b>	<b>0.14</b>	<b>85.5</b>
	<b>CD (p=0.05)</b>	<b>NS</b>	<b>0.49</b>	<b>295.8</b>
	<b>CV (%)</b>	<b>11.9</b>	<b>7.5</b>	<b>9.7</b>
<i>Foliar spray</i>				
<b>F<sub>1</sub></b>	2% Urea	31.6	6.2	2904
<b>F<sub>2</sub></b>	2% DAP	32.2	6.5	3041
<b>F<sub>3</sub></b>	1% KNO <sub>3</sub>	32.8	7.0	3206
<b>F<sub>4</sub></b>	2% 19-19-19	31.8	6.4	3066
	<b>SEm ±</b>	<b>1.22</b>	<b>0.16</b>	<b>67.9</b>
	<b>CD (p=0.05)</b>	<b>NS</b>	<b>0.46</b>	<b>198.2</b>
	<b>CV (%)</b>	<b>13.1</b>	<b>8.4</b>	<b>7.7</b>
	Interaction	NS	NS	NS

**Table.2** Effect of irrigation and foliar nutrition on yield attributes of blackgram

Treatment	Number of clusters plant <sup>-1</sup>	Number of pods cluster <sup>-1</sup>	Number of seeds pod <sup>-1</sup>	1000 seed weight (g)
<b>Irrigation levels:</b>				
I <sub>1</sub> -Control	2.9	5.9	6.0	44.2
I <sub>2</sub> -0.3 IW/CPE ratio	3.5	6.1	6.2	46.9
I <sub>3</sub> -0.4 IW/CPE ratio	3.7	6.0	6.1	47.2
I <sub>4</sub> -0.5 IW/CPE ratio	3.8	6.2	6.3	48.9
SEm ±	0.06	0.14	0.17	0.45
CD (p=0.05)	0.21	NS	NS	1.54
CV (%)	6.1	8.1	9.7	3.3
<b>Foliar spray:</b>				
F <sub>1</sub> -2% urea	3.4	6.0	6.2	44.8
F <sub>2</sub> -2% DAP	3.5	5.9	6.1	47.5
F <sub>3</sub> -1% KNO <sub>3</sub>	3.7	6.1	6.3	48.0
F <sub>4</sub> -2% 19-19-19	3.5	5.8	6.0	46.9
SEm ±	0.09	0.16	0.19	0.22
CD (p=0.05)	0.27	NS	NS	0.64
CV (%)	9.4	9.1	10.8	1.6
<b>Interaction (I × F):</b>				
SEm ±	0.16	0.32	0.39	0.44
CD (p=0.05)	NS	NS	NS	1.28

**Table.3** Effect of irrigation and foliar nutrition on yield of blackgram

Treatment	Seed yield (kg ha <sup>-1</sup> )	Haulm yield (kg ha <sup>-1</sup> )	Harvest index (%)
<b>Irrigation levels:</b>			
I <sub>1</sub> -Control	610	1356	31.1
I <sub>2</sub> -0.3 IW/CPE ratio	710	1604	30.8
I <sub>3</sub> -0.4 IW/CPE ratio	790	1750	31.2
I <sub>4</sub> -0.5 IW/CPE ratio	959	1935	33.2
SEm ±	21	61	0.81
CD (p=0.05)	74	212	NS
CV (%)	9.7	12.8	8.8
<b>Foliar spray:</b>			
F <sub>1</sub> -2% urea	704	1618	30.3
F <sub>2</sub> -2% DAP	782	1631	32.4
F <sub>3</sub> -1% KNO <sub>3</sub>	833	1828	31.2
F <sub>4</sub> -2% 19-19-19	749	1569	32.4
SEm ±	23	55	0.70
CD (p=0.05)	67	161	NS
CV (%)	10.4	11.5	7.6
<b>Interaction (I × F):</b>			
SEm ±	46	110	1.4
CD (p=0.05)	NS	NS	NS

**Table.4** Effect of irrigation and foliar nutrition on nutrient uptake of blackgram

Treatment		Total NPK (kg ha <sup>-1</sup> ) uptake		
		Nitrogen	Phosphorus	Potassium
<i>Irrigation levels</i>				
I <sub>1</sub>	Control	77	16	104
I <sub>2</sub>	0.3 IW/CPE ratio	88	18	120
I <sub>3</sub>	0.4 IW/CPE ratio	96	19	120
I <sub>4</sub>	0.5 IW/CPE ratio	110	21	124
	<b>SEm ±</b>	<b>3.09</b>	<b>0.53</b>	<b>2.92</b>
	<b>CD (p=0.05)</b>	<b>10.7</b>	<b>1.8</b>	<b>10.1</b>
	<b>CV (%)</b>	<b>11.5</b>	<b>9.8</b>	<b>8.6</b>
<i>Foliar spray</i>				
F <sub>1</sub>	2% Urea	98	17	115
F <sub>2</sub>	2% DAP	90	20	117
F <sub>3</sub>	1% KNO <sub>3</sub>	91	18	123
F <sub>4</sub>	2% 19-19-19	93	19	113
	<b>SEm ±</b>	<b>2.58</b>	<b>0.46</b>	<b>2.29</b>
	<b>CD (p=0.05)</b>	<b>NS</b>	<b>1.3</b>	<b>6.6</b>
	<b>CV (%)</b>	<b>9.6</b>	<b>8.6</b>	<b>6.7</b>
	Interaction	NS	NS	NS

## Nutrient uptake

Among the main plot treatments, irrigation at 0.5 IW/CPE ratio recorded the highest nitrogen and phosphorus uptake (110 and 21 kg ha<sup>-1</sup>) which was significantly superior over all other treatments and the lowest nitrogen and phosphorus uptake (77 and 16 kg ha<sup>-1</sup>) was recorded in control plot. The influence of foliar nutrition on nitrogen uptake was found to be non-significant. Foliar spray with 2% urea recorded the highest nitrogen uptake (98 kg ha<sup>-1</sup>) and the lowest nitrogen uptake (90 kg ha<sup>-1</sup>) was recorded in foliar spray of 2% DAP twice at pre-flowering and pod filling stages. The influence of irrigation and foliar nutrition on phosphorus and potassium uptake was found to be significant (Table 4). Among the sub plot treatments, foliar application of 2 % DAP recorded significantly the highest phosphorus uptake (20 kg ha<sup>-1</sup>) and the lowest phosphorus uptake (17 kg ha<sup>-1</sup>) was observed in foliar spray of 2 % urea twice at pre-flowering and pod filling stages.

Among the main plot treatments, irrigation at 0.5 IW/CPE recorded the highest potassium uptake (124 kg ha<sup>-1</sup>) which was on a par with 0.4 IW/CPE and 0.3 IW/CPE and significantly superior over control plot. The lowest potassium uptake (104 kg ha<sup>-1</sup>) was recorded in control plot. Foliar spray with 1 % KNO<sub>3</sub> recorded the highest potassium uptake (123 kg ha<sup>-1</sup>) which was comparable with 2 % DAP and significantly superior to foliar spray of 2 % 19-19-19. The lowest potassium uptake (113kg ha<sup>-1</sup>) was recorded in foliar spray with 2 % 19-19-19 which was comparable with foliar application of 2 % DAP and 2 % urea twice at pre-flowering and pod filling stages. The interaction effect of irrigation levels and foliar nutrition on nitrogen, phosphorus and potassium uptake was found to be non-significant.

The increase in irrigation frequency resulted in higher solubility of nutrients and higher

uptake. Arya *et al.*, (2005) reported that scheduling irrigation to chickpea at 0.9 IW/CPE ratio showed significantly higher N, P and K uptake by seed and stover and was at par with 0.7 IW/CPE ratio. The significant effect of foliar nutrition on nutrient uptake might be due to its easy availability and absorption of nutrients under foliar spray without spending much energy for their transport and without any loss in transit (Srivastava and Srivastava, 1994). The results were in corroboration with Kuttimani and Velayutham (2011a) and Venkatesh and Basu (2011).

Based on the results summarized above it is concluded that one irrigation given at vegetative stage (0.5 IW/CPE ratio) recorded the highest growth parameters, yield and yield attributes and also nutrient uptake over the one irrigation given at flowering and pod filling stages (0.4 and 0.3 IW/CPE ratios). Foliar spray of 1 % KNO<sub>3</sub> recorded the highest growth and yield parameters over 2 % urea, 2 % DAP and 2 % 19-19-19.

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