



RESEARCH ARTICLE

Mechanized Sowing and Sprinkler Method of Irrigation for Summer Irrigated Blackgram

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ABSTRACT

The productivity of pulse crop is low due to two reasons ; cultivation on agriculturally marginal soils and little application of any crop inputs. Among production inputs, irrigation plays a crucial role in enhancing productivity levels. Population maintenance is one of the essential criteria by which yield is affected very much. Three-year research (2015-2017) was conducted at AEC&RI, Kumulur during summer season. Among method of establishment, seeding by machine at raised bed has achieved higher plant population (39.50/ m²), higher number of branches (3.81) per plant, higher number of seeds (3.95) per plant and higher seed yield per (2.61 g) plant, whereas method of sowing by machine at flatbed also on par with the performance on number of branches per plant, number of seeds per pod, per plant seed yield in all the three years. Increase in the quantity of seed rate has achieved increase in plant population, but the seed rate @25 kg/ha has achieved higher number of branches per plant (4.13), higher number of pods (4.50) per plant, per plant seed yield (4.33). Sprinkler method of irrigation required eight numbers of irrigation with the quantity of 431.2 mm and achieved water savings of 14.5% compared to conventional method of irrigation and recorded higher water use efficiency of 2.08kg/cm³. Considering the cost of cultivation, net return and BCR, the treatment combination of sowing by machine at flatbed with the seed rate of @25 kg/ha under sprinkler method of irrigation, has achieved the higher yield (1298 kg/ha) and BCR (4.96).

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INTRODUCTION

Pulses are the essential sources of proteins, vitamins and minerals and are popularly known as “Poor man’s meat” and “rich man’s vegetable”, contribute significantly to the nutritional security of the country. India is bound to be global leader in terms of production and consumer of pulses with 25 percent of total production, 33 percent of the total consumption and 32 percent of global acreage under pulses. Pulses in India are considered a residual crop and grown under rainfed conditions in marginal/less fertile lands. The average productivity of the country is about 660 kg/ha against the average global productivity of 909 kg/ha (Annual report 2016-17). India has the potential to increase acreage by encouraging production of pulses in rice fallows and summer irrigated pulses. Replacement of upland paddy with pulses is another viable option, which has the potential to give better net return to the farmers.

Improper sowing time, low seed rate, defective sowing methods, insufficient irrigation, inadequate

intercultural operation, sowing without proper management are significant agronomic constraints (Ramakrishna et al., 2000 and Reddy, 2009) for low productivity.

The seed rate is the most important factor to maintain optimum plant population on the cultivation of blackgram . It has been observed that the yield of blackgram is greatly affected by seed rate. Therefore, it is necessary to find out optimum seed rate to increase yield of blackgram.

Pulse crops are invariably grown under moisture stress which leads to sub-optimal productivity levels. Scientific scheduling of irrigation, an estimate of the quantity of water to be applied and deployment of water-saving irrigation methods can lead to enhanced yield, higher water and nutrient use efficiency. Use of sprinkler irrigation has enormous potential for saving irrigation water and expanding area under irrigation. Sprinkler method of irrigation has gained popularity in many districts with limited water resources. With this background, three-year research (2015-2017) was conducted at AEC&RI,

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Kumalur during summer season with the objectives to find out the method of irrigation to supplement water requirement for pulse, to find out the optimum plant geometry of pulse production and to improve the productivity of pulses.

MATERIALS AND METHODS

The experiment was conducted in Strip plot design and replicated thrice by using ADT-5 blackgram variety. The treatments consist of two methods of irrigation as main plot treatment (M_1)- Check basin and (M_2)- Micro sprinkler). Three methods of establishment (E_1)- Broadcasting, (E_2)- Multi crop planter-(Turbo seeder) at flatbed and (E_3)- Multi crop planter-(Turbo seeder) at raised bed 90 cm as subplot treatments and three levels of seed rate as (S_1)-20 kg /ha, (S_2)- 25 kg /ha and (S_3)-30 kg /ha as sub-sub plot treatments. These treatments combination were compared with the conventional/farmers practices of broadcasting of seed rate @ 20kg /ha under the flatbed and check basin method of irrigation under summer irrigated condition as control.

The main plot treatments were imposed by using conventional beds and channel method of irrigation and Micro sprinkler method of irrigation having wetting radius of 12 m with sprinkler nozzle head size of ¾ inch and discharge rate of 1800 lph. Sub plot treatment of sowing was done by broadcasting

and sowing by using Multi crop planter-Turbo seeder to the depth of 2.5 cm which is having provision for sowing at different seed rate and possible to form a raised bed at the size of 90 cm as well as depth control wheel to control the depth of sowing. The sub-subplot treatment of three levels of seed rate were calibrated for machine sowing to obtain the desired rate of seed for each level (20kg, 25 kg and 30 kg/ha). Agronomic practices recommended for summer irrigated crop were followed on fertilizer management (25:50:25 NPK Kg/ha), weed management of one herbicide application and one hand weeding and pest and disease management.

Various growth and yield parameters viz., plant population (numbers/sq.m), establishment percentage, number of branches /plant, plant height at 15 days interval, number of pods/plant, test weight (g), seed yield (g/plant) were observed and yield (kg/ha), BCR and net return (Rs./ha) were calculated. The number of irrigation, quantity of water required for each irrigation, total quantity of water required were observed and water savings and water use efficiency were calculated.

RESULTS AND DISCUSSION

The result of each year of research with each factor is presented and pooled analysis for three years on significant yield and economics factors were calculated and presented.

Table 1. Influence of method of irrigation, establishment and seed rate on crop establishment and yield characters of black gram

Treatments	Plant population (Number/m ²)	Branches (Number/plant)	Pods (Number/branch)	Seeds (Number/Pod)	Seed yield (g/plant)	BCR
Method of irrigation						
M_1 : Check basin	34.67	3.46	3.17	3.65	2.16	2.20
M_2 : Micro sprinkler	36.22	3.94	3.19	3.61	2.49	2.69
Mean	35.45	3.70	3.18	3.63	2.33	2.45
SED	0.64	0.11	-		0.14	
CD (p=0.05)	1.40	0.24	NS	NS	0.24	
Method of establishment						
E_1 : Broad casting	31.67	3.53	2.86	3.18	1.87	1.94
E_2 : Happy seeder at flat bed	35.17	3.76	3.43	3.76	2.52	2.66
E_3 : Happy seeder at raised bed (90 cm)	39.50	3.81	3.23	3.95	2.61	2.75
Mean	35.45	3.70	3.17	3.63	2.33	2.45
SED	0.66	0.08	0.24	-	0.28	
CD (p=0.05)	1.34	0.20	0.42	NS	0.54	
Seed rate						
S_1 : @ 20 kg ha ⁻¹	32.00	3.28	3.04	3.53	1.79	1.62
S_2 : @ 25 kg ha ⁻¹	35.17	4.17	3.31	3.75	2.89	2.92
S_3 : @30 kg ha ⁻¹	39.17	3.65	3.17	3.62	2.31	2.79
Mean	35.45	3.70	3.17	3.63	2.33	2.44
SED	1.48	0.42	0.11	-	0.52	
CD (p=0.05)	3.08	0.68	0.22	NS	0.98	

Table 2. Influence of method of Irrigation on water requirement and water use efficiency of black gram.

Method of irrigation	Check basin method of irrigation (M ₁)	Sprinkler method of irrigation (M ₂)
Number of irrigation	6	8
Total quantity of water applied (mm)	509.6	431.2
Average yield (kg/ha)	754	901
Water use efficiency or water productivity(kg/cm ³ or kg/ha/mm)	1.48	2.08
Water savings (%) over conventional method of irrigation	-	14.5

The experimental results of first-year (2015) showed that sprinkler method of irrigation has achieved higher plant population (33.89/m²) as well as higher establishment percentage, higher pods

(4.00) per branches, higher number seeds (4.4) per pod, higher yield (1069 kg/ha) and higher BCR (4.88) when compared to the conventional practices of check basin method of irrigation.

Among method of establishment, seeding by machine at raised bed has recorded higher plant population (35.50/ m²), higher number of branches (3.63) per plant, higher number of seeds (4.70) per plant, whereas method of sowing by machine at flatbed was also on par with the performance on population, number of branches per plant, number of seeds per pod, per plant seed yield. Increase in the quantity of seed rate helped to achieve increase in plant population, but the seed rate @25 kg/ha has achieved higher number of branches per plant (4.13), higher number of pods (4.50) per plant, per plant seed yield (4.33) and higher BCR when compared to the broadcasting method of sowing in flatbed with the seed rate of 20 kg/ha.

Table 3. Influence of combination treatment of method of irrigation, method of establishment and seed rate on yield of blackgram (kg/ha)

Treatments	M ₁											
	S ₁				S ₂				S ₃			
Year	2015	2016	2017	Mean	2015	2016	2017	Mean	2015	2016	2017	Mean
E1	421	298	334	351	441	390	635	489	485	500	662	549
E2	648	422	557	542	1129	859	962	983	1287	651	968	969
E3	604	395	625	541	1856	887	886	1210	1473	676	874	1008
Mean	558	372	505		1142	712	828		1082	609	835	
Treatments	M ₂											
	S ₁				S ₂				S ₃			
Year	2015	2016	2017	Mean	2015	2016	2017	Mean	2015	2016	2017	Mean
E1	478	322	421	407	801	491	909	734	1056	640	833	843
E2	772	510	655	646	1571	1153	1171	1298	1456	846	1147	1150
E3	687	498	576	587	1414	1117	1087	1206	1369	1012	1040	1140
Mean	646	443	551		1262	920	1056		1294	833	1007	
	Main plot(M)	Sub plot(S)	sub-sub plot(Sb)	Interaction MxS	Interaction SxSb	Interaction SbxS	Interaction MxSb		Interaction SbxM		Interaction MxSxSb	
SED	32	40	60	57	93	103		76		84		72
CD(p=0.05)	73	90	122	127	195	212		159		173		168

The combination treatment of sowing by machine at flat bed and seed rate @25 kg/ha achieved higher yield per hectare in the sprinkler method of irrigation.

Second-year research (2016) results revealed that sprinkler method of irrigation has achieved higher plant population (31.56/m²), higher number of pods (3.86) per branch, higher number seeds (4.16) per pod, higher yield (732 kg/ha) and higher BCR (3.11). Among method of establishment, seeding by machine at raised bed achieved higher plant population (34.20/ m²), higher number of

branches (4.12) per plant, higher number of seeds (4.30) per plant, whereas method of sowing by machine at flatbed was on par with the performance on population, number of branches per plant, number of seeds per pod, per plant seed yield. Increase in the quantity of seed rate helped to achieve increase in plant population, but the seed rate @25 kg/ha has achieved higher number of branches per plant (4.08), higher number of pods (3.64) per plant, number of seed per pod (3.98) and higher BCR compare to 30 kg/ha as well as recommended seed rate of 20 kg/ha under

conventional method of cultivation. The combination treatment of sowing by machine and seed rate @ 25 kg/ha with sprinkler method of irrigation achieved higher yield of 1117 kg/ hectare.

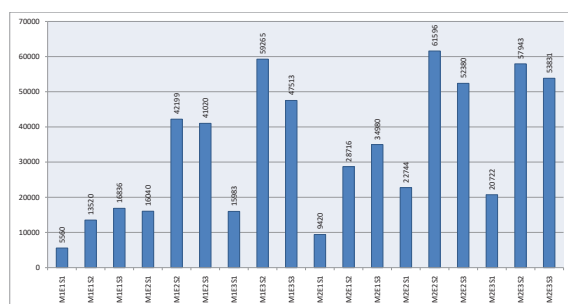
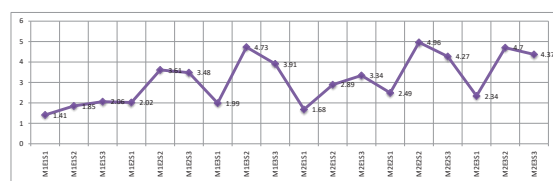


Figure 1. Influence of combination treatment of method of irrigation, method of establishment and seed rate on Net income (Rs./ha)

Mainplot : Two methods of irrigation (M_1 : Check basin & M_2 : Micro sprinkler) **Subplot:** Three methods of establishment (E_1 : Broad casting, E_2 : Multi crop planter-Turbo seeder & E_3 : Multi crop planter-Turbo seeder at raised bed 90 cm) **Sub sub plot :** Three levels of seed rate(S_1 : @ 20 kg /ha, S_2 : @ 25 kg /ha & S_3 : @ 30 kg /ha).

The third-year experimental results (2017) showed that sprinkler method of irrigation achieved higher plant population (36.22/m²), higher number of branches (3.70) per plant, higher number of pods (3.18) per branch, higher seed yield (2.49 g) per plant, higher yield (901 kg/ha) and higher BCR (2.69). Among method of establishment, seeding by machine at raised bed achieved higher plant population (39.50/ m²), higher number of branches (3.81) per plant, higher number of seeds (3.95) per plant and higher seed yield per (2.61 g) plant, whereas method of sowing by machine at flatbed is on par with the performance on number of branches per plant, number of seeds per pod, per plant seed yield (Table 1). Shivkumar and Mishra 2001) noticed no difference in grain yield due to broad bed and



Mainplot : Two methods of irrigation (M_1 : Check basin & M_2 : Micro sprinkler) **Subplot:** Three methods of establishment (E_1 : Broad casting, E_2 : Multi crop planter-Turbo seeder & E_3 : Multi crop planter-Turbo seeder at raised bed 90 cm) **Sub sub plot :** Three levels of seed rate(S_1 : @ 20 kg /ha, S_2 : @ 25 kg /ha & S_3 : @ 30 kg /ha).

Figure 2. Influence of combination treatment of method of irrigation, method of establishment and seed rate on BCR

Mainplot : Two methods of irrigation (M_1 : Check basin & M_2 : Micro sprinkler) **Subplot:** Three methods of establishment (E_1 : Broad casting, E_2 : Multi crop planter-Turbo seeder & E_3 : Multi crop planter-Turbo seeder at raised bed 90 cm) **Sub sub plot :** Three levels of seed rate(S_1 : @ 20 kg /ha, S_2 : @ 25 kg /ha & S_3 : @ 30 kg /ha).

furrow sowing as compared to flatbed sowing despite higher growth and yield attributes. Sprinkler method of irrigation required eight numbers of irrigation with the quantity of 431.2 mm and achieved water savings of 14.5% compared to conventional

method of irrigation and recorded higher water use efficiency of 2.08 kg/cm³ (Table-2). Increase in the quantity of seed rate helped to achieve increase in plant population up to certain level of @25 kg/ha and achieved higher number of branches per plant (4.17), higher number of pods (3.31) per plant, number of seed per pod (3.75) and higher (2.89) gram per plant yield and BCR (2.92). Similar findings were also obtained by Singh et al. (1986) sowing rates of 20, 30 or 40 kg seeds/ha in blackgram produced seed yields of 1.22, 1.39 and 1.26 t/ha, respectively. Subramani and Solaimalai (2000) reported that a plant population of 40 plants/m² increased LAI and grain yield in blackgram.

The yield and economics of three year studies were pooled and analyzed and presented in Table-3 and Figure 1&2. The same trend was observed in yield and BCR in all the three years.

The combination treatment of sowing by machine at flatbed and increased seed rate @ 25 kg/ha under sprinkler method of irrigation has achieved a higher yield of (1298 kg/ha). The combination treatment of sowing by machine at flatbed and increased seed rate @25 kg/ha with sprinkler method of irrigation is essential to achieve higher yield per hectare with higher BCR.

CONCLUSION

Sowing by machine at flatbed with the seed rate of @25 kg/ha by sprinkler method of irrigation is essential to achieve less quantity of irrigation water (431.2 mm) and higher water use efficiency (2.08 kg/cm³) as well as saving of water to the tune of 14.5% with higher BCR (4.96) and higher yield of (1298 kg/ha) compared to the conventional practices of check basin method of irrigation.

Sowing by machine at flatbed with seed rate @25 kg/ha with sprinkler method of irrigation achieved higher yield (1298 kg/ha), net income (Rs.61596/ha) and WUE (2.08 kg/cm³) achieved by the contribution of higher yield parameters of higher number of branches (3.96) per plant, seeds per (3.71) plant and seed yield (2.69) per plant whereas farmers practices recorded number of branches (3.42) per plant, seeds per (3.02) plant and seed yield (1.94) per plant.

Sowing by machine at flatbed with seed rate @25 kg/ha with sprinkler method of irrigation along with recommended agronomic practices of summer irrigated blackgram is essential to achieve the higher yield, net income, BCR and WUE.

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