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Evaluation of crop estiblishment techniques and herbicide mixtures for enhancing the productivity of Rice fallow blackgram (*Vigna mungo* L.)

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ABSTRACT

A field experiment conducted at the Agricultural Research Station, Ghantasala on black alluvial clay soils to study the "Evaluation of tank mix herbicide under different crop establishment techniques in rice fallow blackgram (*Vigna mungo* L.)" during *rabi* 2023-24. The experiment was laid out in a split plot design, replicated thrice. The main plot treatments consisted of *viz*., Broadcasting of blackgram seed 2 to 3 days prior to manual harvesting of rice, Broadcasting of blackgram seed prior to harvest of rice by combine harvester followed by running slasher, Line sowing of blackgram seeds with tractor drawn dibbler (after harvest of rice by combine harvester followed by running slasher). The subplot treatments consisted of, Pendimethalin 38.7% CS @ 677 g a.i.ha^{-1} as PE (SMA) *fb* Clethodim 25% w/w @ 125 g a.i.ha^{-1} + Imazethapyr 10% SL @ 50 g ha^{-1} (TM) as PoE, Pendimethalin 38.7% CS @ 677 g a.i.ha^{-1} as PE (SMA) *fb* Haloxyfop-R-methyl 10.5% EC @ 125 g a.i.ha^{-1} + Imazethapyr 10%SL @ 50 g ha^{-1} (TM) as PoE, Hand weeding at 20 DAS and Control (weedy check). All the post emergence herbicides were applied at 20 DAS. The predominant weed species observed in experimental plot were grasses like *viz., Echinochloa colonum* and *Panicum ramosum*, sedges *viz., Cyperus rotundus, Cyperus kyllinga* and broad-leaved weeds like *Grangea maderaspatana, Cardiospermum helicacabum, Phyllanthus maderaspatensis* and *Chrozophora rottleri.* Broadleaved weeds were found to be dominant followed by grasses and sedges. Among the different methods of sowing, broadcasting of blackgram seed 2 to 3 days prior to manual/mechanical harvesting of rice registered significantly higher crop growth parameters and yield attributing characters that resulted in higher yield of rice fallow blackgram.

Key words: *Blackgram, Combine harvest, Rice fallow and Tractor drawn dibbler.*

Pulses play a crucial source of dietary protein and also enrich soil fertility through nitrogen fixation, making them essential for sustainable agriculture. They are grown in various conditions, including irrigated, rainfed, and rice fallow ecosystems. In Ghantasal, rice fallow pulses account for a major share in total pulse production with blackgram being the dominant crop in this ecosystem.

The productivity of rice fallow blackgram is generally very low due to various biotic and abiotic stresses, poor crop management practices and socio-economic constraints (Behra *et al*., 2014). Soil, water and weeds are the major limiting factors which lead to low productivity in rice fallow blackgram.

With extensive adoption of mechanised harvest in paddy, the population of blackgram in the rice-blackgram relay cropping system is drastically affected due to the chain traverse by combine harvester. This has emerged as major abiotic stress which resulted in poor yield.

To maximize the benefits of growing pulses after rice, it's essential to ensure a sufficient plant population. Traditionally, broadcasting of pulse seeds two to three days before harvesting rice, when the soil is still moist. However, this method can lead to uneven germination and plant distribution. Further with the increasing use of machine harvesting, which can damage newly planted pulse crops due to wheel traffic, new strategies are needed to enhance crop productivity and offset potential yield losses. This study aims to find alternative crop establishment methods to boost the productivity of rice fallow blackgram**.**

MATERIAL AND METHODS

The present experiment "Evaluation of tank mix herbicides under different crop establishment

techniques in rice fallow blackgram (*Vigna mungo* L.) was conducted during *rabi*, 2023-24 in black alluvial soils of Agricultural Research Station, Ghantasala, Andhra Pradesh.

The experiment was laid out in a split plot design, replicated thrice with three crop establishment techniques as main plots and four weed management practices as sub plots. The main plot treatments consisted of (i) Broadcasting of blackgram seed 2 to 3 days prior to manual harvesting of rice (ii) Broadcasting of blackgram seed prior to harvest of rice by combine harvester followed by runner slasher (iii) Line sowing of blackgram seeds with tractor drawn dibbler (after harvest of rice by combine harvester followed by runner slasher). The subplot treatments consisted of (i) Pendimethalin 38.7% CS @ 677 g a.i.ha^{-1} as PE (SMA) *fb* Clethodim 25% w/w @ 125 g a.i.ha^{-1} + Imazethapyr 10% SL @ 50 g ha^{-1} (TM) as PoE at 15-20 DAS, (ii) Pendimethalin 38.7% CS @ 677 g a.i.ha^{-1} as PE (SMA) *fb* Haloxyfop -R-butyl 10.5% EC @ 125 g a.i.ha^{-1} + Imazethapyr 10%SL @ 50 g ha^{-1} (TM) as PoE at 15-20 DAS, (iii) Hand weeding at 20 DAS, (iv) Control (weedy check). (Blackgram cultivar LBG 752 was used in the present study.)

The data on growth at regular intervals and yield attributes at the time of harvest were recorded. The seed yield was measured as total yield per plot and transformed to kg ha^{-1}. The data analyzed statistically as per the method suggested by Gomez and Gomez (1984).

Table 1. Growth, yield parameters and yield in rice fallow backgram as affected by crop establish ment techniques and weed management practices.

Treatments	Plant population (No. m^{-2})	Plant highest (cm) at harvest	No. of seeds pods $^{-1}$	No of pod plant^{-1}	Test weight	Yield (kg ha^{-1})
Crop Establishment Methods						
M_1- Broadcasting 2 to 3 days prior to manual harvesting of paddy	32	40.47	6.88	15.22	47.59	1317.32
M_2- Broadcasting 2 to 3 days prior to harvesting of rice by combine harvester *fb* runner slasher	29	38.47	6.62	12.43	46.5	1067.06
M_3-Line sowing with tractor drawn dibbler after harvest of rice *fb* runner slasher	27	25.37	6.57	10.07	45.72	941.88
S.Em(±)	0.13	0.41	0.1	0.25	0.82	33.72
CD (P=0.05 %)	0.5	1.6	NS	1	NS	132.4
C.V (%)	7.73	9.03	8.07	7.02	6.09	10.57
weed management practices						
S_1-Pendimethalin 38.7% CS @ 677 g a.i./ha as PE (SMA) *fb* Clethodim 25% w/w @ 125 g a.i./ha along with Imazethapyr 10% SL @ 50 g/ha (TM) as PoE at 15-20 DAS.	30.22	37.69	6.86	12.9	48.19	1276.5
S_2- Pendimethalin 38.7% CS @ 677 g a.i./ha as PE (SMA) *fb* Haloxyfop -R-butyl 10.5% EC @125 g a.i./ha + Imazethapyr 10%SL @ 50 g/ha (TM) as PoE at 15-20 DAS.	30	36.24	6.79	14.11	46.58	1149.12
S_3 - Hand weeding at 20 DAS	29.11	33.87	6.57	12.12	46.25	1026.5
S_4 - Control (weedy check)	28.44	31.6	6.53	11.4	45.4	969.77
S.Em(±)	0.54	0.92	0.15	0.69	1.13	42.27
CD (P=0.05 %)	NS	2.74	NS	2.05	NS	1343.51
C.V (%)	9.82	9.87	6.82	16.45	7.3	12.29
Interaction	NS	NS	NS	NS	NS	NS

The data subjected to square root transformation ("X+0.5). The figures in parenthesis are original values.
Note: SMA: Sand Mix Application; TM: Tank Mix; PoE: Post-Emergence; PE: Pre-Emergence

RESULTS AND DISCUSSION

Growth and yield attributes

The data in (Table 1) shows that different methods of planting blackgram resulted in varying plant populations per unit area. The highest plant population (32 m^{-2}) was achieved when blackgram was broadcasted 2-3 days before manual rice harvest,(M_1) and this was followed by broadcasting before rice harvest with combine harvester (29 m^{-2}). However, planting blackgram in rows using a tractor-drawn dibbler after combine harvester rice harvest, followed by a runner slasher, resulted in poor crop establishment. Additionally, using a seed drill to plant blackgram led to rapid loss of residual moisture due to deep furrows, resulting in poor germination and establishment.

The data also showed that broadcasting blackgram seeds 2 to 3 days before manual rice harvest resulted in the tallest plants, likely due to the favorable microclimate provided by the standing rice crop, which promoted healthy growth in the early stages. In contrast, planting blackgram in rows using a tractor-drawn dibbler after rice harvest and using a runner slasher resulted in shorter plants, probably because the delayed establishment of blackgram seeds after rice harvest hindered their growth. This finding is consistent with Amuthaselvi *et al*. (2019), who also reported that broadcasting method in rice fallow blackgram resulted in higher plant population per unit area.

Sowing of blackgram by broadcasting 2 to 3 days before the manual harvest of paddy highest number of pods per plant (20.05). The number of pods per plant did not vary among the different crop establishment methods as even lesser population per unit area had favoured the per plant yield parameters. The reason might be due to less competition between the plants where the feeding zone per plant was more.

Table 2 . Weed population at 45DAS in rice fallow backgram as affected by crop establishment techniques and weed manage ment practices.

Treatments	Total Number of weeds (No.m^{-2}) at 45DAS	Total drymatter of weeds (g m^{-2}) at 45DAS	WCE (%) at 45DAS
Crop establishment methods			
M_1- Broadcasting 2 to 3 days prior to manual harvesting of paddy	10.27(95.58)	4.34(19.19)	-
M_2- Broadcasting 2 to 3 days prior to harvesting of rice by combine harvester *fb* runner slasher	10.94(109.05)	4.58(21.79)	-
M_3-Line sowing with tractor drawn dibbler after harvest of rice *fb* runner slasher	11.65(124.33)	5.00(25.64)	-
S.Em(±)	0.09	0.07	-
CD (P=0.05 %)	0.34	0.29	-
C.V (%)	6.15	8.15	-
Weed management practices			
S_1-Pendimethalin 38.7% CS @ 677 g a.i./ha as PE (SMA) *fb* Clethodim 25% w/w @ 125 g a.i./ha along with Imazethapyr 10% SL @ 50 g/ha (TM) as PoE at 15-20 DAS.	7.81(53.56)	3.74(13.61)	65.08
S_2- Pendimethalin 38.7% CS@677 g a.i./ha as PE (SMA) *fb* Haloxyfop -R-butyl 10.5% EC @125 g a.i./ha + Imazethapyr 10%SL @ 50 g/ha (TM) as PoE at 15-20 DAS.1026.50	8.37(62.05)	3.76(13.67)	64.93
S_3 - Hand weeding at 20 DAS	11.42(119.45)	4.79(22.57)	42.09
S_4 - Control (weedy check)	14.76(203.56)	6.27(38.98)	0
S.Em(±)	0.12	0.05	-
CD (P=0.05 %)	0.56	0.15	-
C.V (%)	7.79	8.92	-
Interaction	NS	NS	-

SMA: Sand Mix Application; TM: Tank Mix; PoE: Post-Emergence; PE: Pre-mergence

Table 3. Economics of rice fallow blackgram as affected by different crop establishment methods and weed management practices.

Treatments	Seed yield	COC	Gross returns	Net returns	B:C ratio
M_1S_1	1639	26625	116513.09	88453.16	3.322184
M_1S_2	1251	24530	84736.32	63658.83	2.595142
M_1S_3	1148	28540	81142.96	52336	1.833777
M_1S_4	962	21040	46709	46806.93	2.224664
M_2S_1	1140	26625	68211.17	53788.16	2.020213
M_2S_2	1238	24530	81558.97	62648.12	2.553939
M_2S_3	1010	28540	69568.07	42597.05	1.492538
M_2S_4	880	21040	67196.3	40912.88	1.944529
M_3S_1	1056	29525	67300.51	44590.67	1.510268
M_3S_2	952	27430	61237.1	39337.99	1.434123
M_3S_3	937	31440	61330.3	34416.6	1.094676
M_3S_4	793	23940	54868.65	31741.72	1.325887

Economic analysis

Blackgram sown 2 to 3 days before the manual harvest of paddy recorded the highest net return ([1] 62813.73 ha^{-1}) and B:C ratio of 2.49 (Table 3), which was closely followed by blackgram sown two to three days before the harvest of paddy with combined harvester ([1] 449986.55 ha^{-1} and 2). The net return and B:C ratio was lowest in line sowing with tractor drawn dibbler after harvest of rice by combine harvester.

Thus, sowing of blackgram 2 to 3 days before harvest of rice recorded higher growth attributing and yield attributing characters results higher yield compared to other crop establishment methods.

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