



EFFECT OF IMPROVED MANAGEMENT PRACTICES, MICROBIAL CONSORTIA AND MOBILE SPRINKLER IRRIGATION ON SOIL MOISTURE DYNAMICS AND PRODUCTIVITY OF RICE FALLOW BLACK GRAM

S. Rathika*, V. Ravi and T. Ramesh

Tamil Nadu Rice Research Institute (TRRI), TNAU, Aduthurai - 612 001 (Tamil Nadu), India.

Abstract

Field experiments were conducted at Tamil Nadu Rice Research Institute, Aduthurai during rice fallow season 2013 and 2014 to evaluate the effect of improved management practices, microbial consortia and mobile sprinkler irrigation on soil moisture dynamics and productivity of rice fallow black gram. The experiments were laid out in randomized block design with three replications. The treatments comprised of improved management practices (IMP), IMP *fb* TNAU Microbial consortia spray on paddy stubbles immediately after harvest, IMP *fb* irrigation with mobile sprinkler at 30 and 45 DAS, IMP *fb* TNAU Microbial consortia spray *fb* irrigation with mobile sprinkler at 30 and 45 DAS and it was compared with farmers practice. The results revealed that the moisture percentage at the time sowing of black gram ranged from 34.9 to 35.7 % in 0-5 cm depth, 32.9 to 33.6 % in 5-10 cm depth and 30.9 to 31.9 % in 10-15 cm depth. The moisture level was higher in the plots that received irrigation twice at 30 and 45 DAS through mobile sprinkler. Adoption of improved management practices *fb* TNAU Microbial consortia spray on paddy stubbles immediately after harvest *fb* irrigation with mobile sprinkler at 30 and 45 DAS of rice fallow black gram recorded higher plant population per m², plant height, nodules/plant, yield attributes, yield, net return and BC ratio. Hence, adoption of improved management practices *fb* TNAU Microbial consortia spray on paddy stubbles immediately after harvest *fb* irrigation with mobile sprinkler at 30 and 45 DAS could be recommended for getting higher productivity of black gram under rice fallow condition.

Key words : Rice fallow black gram, improved management practices (IMP), TNAU microbial consortia, mobile sprinkler irrigation, soil moisture dynamics, yield.

Introduction

Black gram is one of the important pulse crop in Indian agriculture. The importance of this crop than other pulse crop is by virtue of its high nutritional value, short duration, adaptability to all season and suitability to various cropping systems. It is grown during the months of January to March in Cauvery Delta Zone of Tamil Nadu under rice fallow condition. It grows in the residual soil moisture, which is broadcast at 7-10 days before the harvest of paddy crop. Since the black gram is grown under paddy stubbles, it has to survive in the residual nutrients and moisture present in the soil, besides frost and mist available during the period and complete the lifecycle within 65-70

days of sowing (Ramesh *et al.*, 2016). However, yield recorded (300-500 kg/ha.) in this ecosystem is highly variable and mostly depends on the management practices followed. The poor yield of rice fallow black gram is mainly attributed to the use of poor quality seeds, poor germination of seeds, water stress at flowering stage, no fertilizer application, non adoption of DAP spraying and no weed management. Hence, the present study was undertaken to evaluate the effect of improved management practices, microbial consortia and mobile sprinkler irrigation on soil moisture dynamics and productivity of rice fallow black gram.

Materials and Methods

Field experiments were conducted at Tamil Nadu

*Author for correspondence : E-mail: rathikaselvaraj@gmail.com

Rice Research Institute, Aduthurai during rice fallow season 2013 and 2014. The soil of the experimental field was alluvial clay with pH of 7.8 and EC of 0.46 dS/m. The experimental soil was low, high and medium in available nitrogen, phosphorus and potassium contents, respectively. The experiments were laid out in randomized block design with three replications.

Treatment details

T₁ - Farmers practice

T₂ - Improved management practices

T₃ - T₂+ TNAU Microbial consortia spray on paddy stubbles immediately after harvest.

T₄ - T₂+ Irrigation with mobile sprinkler at 30 and 45 DAS

T₅ - T₃+ Irrigation with mobile sprinkler at 30 and 45 DAS

The black gram cultivar namely ADT 3 was sown 7 days prior to harvest of paddy with the seed rate of 30 kg/ha. The seeds were treated with biofertilizers (*Rhizobium* at 600g/ha) and Bio-control agent (*Trichoderma viride* at 4 g/kg of seed) prior to sowing. Paddy was harvested by leaving the stubbles to the height of 30 cm. TNAU microbial consortia (Bio-mineralizer) (2 kg/ton of residue) was applied on paddy stubbles immediately after harvest in the treatments T₃ and T₅. Early post emergence herbicide namely Quizalofop ethyl at 50 g/ha was applied to control the growth of stubbles, shredded grains and grassy weeds on 15 DAS.

Irrigation with mobile sprinkler was done on 30 and 45 DAS to the plots as per the treatments (T₃ and T₅). Foliar nutrition with TNAU Pulse wonder at 5 kg/ha was

given at flowering stage and at 15 days after first spray.

Soil moisture dynamics were studied by taking soil samples at regular intervals right from last irrigation to paddy at 0-5 cm, 5-10 cm and 10-15 cm depths. Soil resistance was also measured at 0-5 cm, 5-10 cm and 10-15 cm depths on 35 and 50 DAS. Observations on plant population (No./m²), growth and yield parameters of black gram *viz.*, plant height, nodules/plant, numbers of pods/plant, number of seeds/pod and 100 seed weight were recorded. Seed yield was recorded at the time of harvest from the net plot area and expressed as Kg/ha. Economics of different treatments were worked out by using the current market price of inputs and black gram seed. All the recorded data were analyzed statistically as per the method suggested by Gomez and Gomez (1984).

Results and Discussion

Effect on soil moisture dynamics

The soil moisture was measured in three depths namely 0-5 cm, 5-10 cm and 10-15 cm at 7 days interval from black gram sowing up to harvest. The moisture percentage at the time sowing black gram ranged from 34.9 to 35.7 % in 0-5 cm depth, 32.9 to 33.6 % in 5-10 cm depth and 30.9 to 31.9 % in 10-15 cm depth across the treatments (Fig. 1-3). The higher moisture level at surface layer as compared to subsurface was due to the last irrigation impounded for paddy crop. The moisture begun to deplete at faster rate during the initial stage of crop growth at 0 - 5 cm layer while sub soil layers recorded more moisture from 21 DAS because of insulation from sunlight. The moisture level was higher in the plots that received irrigation twice at 30 and 45 DAS through mobile sprinkler. The microbial consortia did not have positive

Table 1: Farmers practice Vs Improved management practice.

Particulars	Farmers practice	Improved management practice
Variety	Local	ADT 3
Seed Rate (Kg/ha.)	20	30
Seed treatment	No	Treated with bio fertilizer (<i>Rhizobium</i>) and fungicides <i>Trichoderma viride</i>
Weed management	No	Early post- emergence herbicide (Quizalofop ethyl at 50g/ha)
Foliar nutrition	No	TNAU Pulse wonder at 5 kg/ha

Table 2: Effect of treatments on soil resistance (M pa) under rice fallow black gram (Pooled mean of two years).

Treatments	Soil resistance (M pa)					
	0 – 5 cm		5 – 10 cm		10 – 15 cm	
	35 DAS	50 DAS	35 DAS	50 DAS	35 DAS	50 DAS
T ₁ - Farmers practice	370	800	350	800	320	800
T ₂ - Improved management practice	340	800	310	800	280	800
T ₃ - T ₂ + TNAU microbial consortia spray	300	800	270	800	250	800
T ₄ - T ₂ + mobile sprinkler irrigation at 30 th and 45 th DAS	280	640	250	750	220	800
T ₅ - T ₃ + mobile sprinkler irrigation at 30 th and 45 th DAS	270	620	230	760	200	800

Table 3: Effect of treatments on plant population/m², plant height, nodules/plant of black gram under rice fallow condition (Pooled mean of two years).

Treatments	Plant population /m ²	Plant height at harvest (cm)	Nodules/plant
T ₁ - Farmers practice	22	26	8
T ₂ - Improved management practice	27	34	13
T ₃ - T ₂ + TNAU microbial consortia spray	27	36	15
T ₄ - T ₂ + mobile sprinkler irrigation at 30 th and 45 th DAS	29	42	18
T ₅ - T ₃ + mobile sprinkler irrigation at 30 th and 45 th DAS	30	46	20
CD (P=0.05)	2.2	3.1	0.9

Table 4: Effect of treatments on yield parameters, seed yield and economics of black gram under rice fallow condition (Pooled mean of two years).

Treatments	No. of Pods/plant	No. of Seeds/pod	100 seed weight(g)	Seed yield (kg/ha)	Net return (Rs./ha)	BC ratio
T ₁ - Farmers practice	18	5.5	3.5	328	5420	1.54
T ₂ - Improved management practice	20	5.7	3.8	445	9400	2.12
T ₃ - T ₂ + TNAU microbial consortia spray	20	5.8	3.9	477	10280	2.17
T ₄ - T ₂ + mobile sprinkler irrigation at 30 th and 45 th DAS	23	5.8	4.0	516	11640	2.29
T ₅ - T ₃ + mobile sprinkler irrigation at 30 th and 45 th DAS	25	5.9	4.1	534	12520	2.39
CD (P=0.05)	1.6	NS	0.3	36	-	-

influence on soil moisture conservation.

Effect on soil moisture resistance

In general, soil resistance decreased when depth increased. Treatments had marked influence on soil resistance (Table 2). The soil resistance was lower under treatment receiving improved management practice (IMP) + TNAU Microbial consortia spray + irrigation with mobile sprinkler at 30 and 45 DAS followed by same without TNAU Microbial consortia at 0-5 and 5-10 soil depth in 35 and 50 DAS. However, the soil resistance was same in all the treatments under 10-15 cm soil depth at 50 DAS. The soil resistance was higher in farmers practice at both stage of observation in all soil depths.

Effect on growth and yield parameters

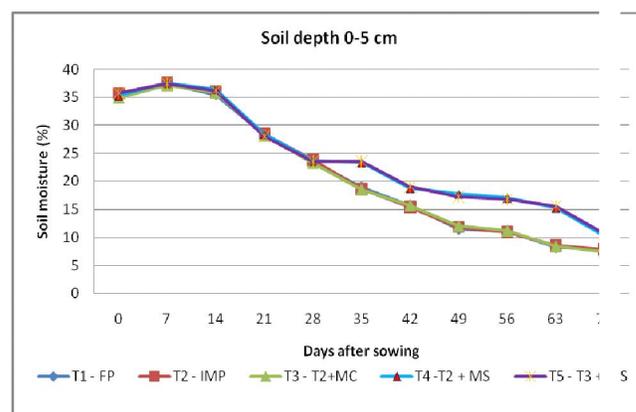
The plant population per m² was significantly lower in farmers practice than other treatments. The highest plant population per m² was recorded with IMP + TNAU Microbial consortia spray + irrigation with mobile sprinkler at 30 and 45 DAS and it was followed by IMP + irrigation with mobile sprinkler at 30 and 45 DAS. This might be due to that better moisture availability to rice fallow black gram resulted in lesser mortality of plants during summer and thus higher plant population/m². This is in conformity with the findings of Rathika and Ramesh (2018).

The plant height, nodules per plant and yield parameters *viz.*, number of pods per plant and 100 seed weight were higher in the treatment receiving IMP + TNAU Microbial consortia spray + irrigation with mobile

sprinkler at 30 and 45 DAS which was followed by IMP + irrigation with mobile sprinkler at 30 and 45 DAS. Increased available soil moisture due to mobile sprinkler irrigation favoured higher plant height. This is in conformity with the findings of Sekhon *et al.* (1994) and Sheoran *et al.* (2001). Irrigation during critical stages improved the crop growth, reduced the flower dropping and favoured more number of pods/plant and better grain filling. This is in line with the findings of Siddique *et al.* (2004) and Rathika and Ramesh (2018). The plant height and yield parameters were lower in farmers practice. Number of seeds per pod was not varied significantly among different treatments.

Effect on seed yield

The seed yield of black gram was significantly higher

**Fig. 1:** Soil moisture dynamics at 0-5 cm.

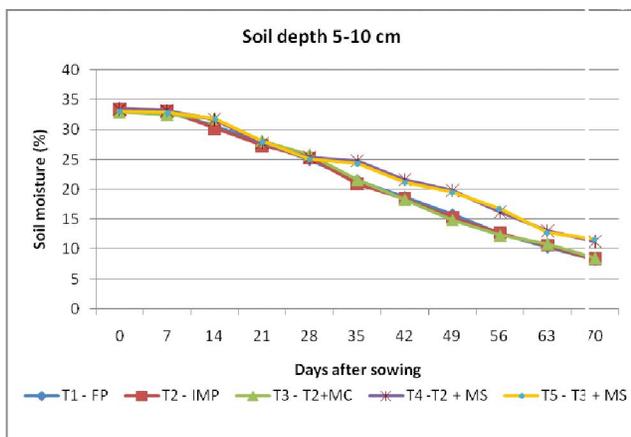


Fig. 2: Soil moisture dynamics at 5-10 cm.

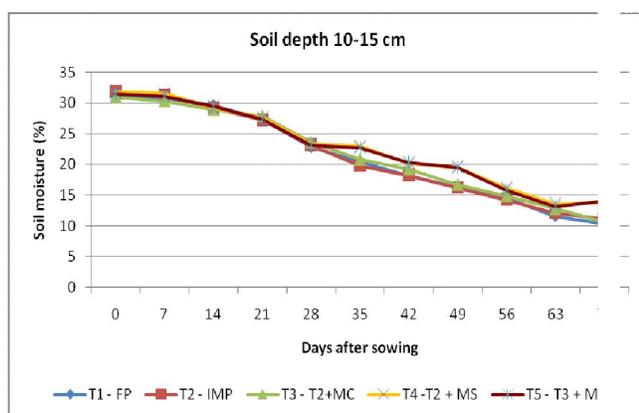


Fig. 3: Soil moisture dynamics at 10-15 cm.

with IMP + TNAU Microbial consortia spray + irrigation with mobile sprinkler at 30 and 45 DAS (534 kg/ha) and it was on par with IMP + irrigation with mobile sprinkler at 30 and 45 DAS (516 kg/ha). The seed yield was lower in farmers practice (328 kg/ha). This might be due to higher moisture maintained under these treatments could have favoured the growth of black gram and its uptake of nutrients from the soil. As rice fallow pulse is highly dependent on residual soil moisture as well as nutrients, depletion of soil moisture at a faster rate during the peak summer season hindered the crop growth thereby resulted in heavy yield loss in other treatments. This is in agreement

with the findings of Siddique *et al.* (2004).

Effect on economics

The maximum net return and BC ratio were recorded with IMP + TNAU Microbial consortia spray + irrigation with mobile sprinkler at 30 and 45 DAS (Rs. 12520/ha and 2.39) and it was followed by IMP + irrigation with mobile sprinkler at 30 and 45 DAS (Rs. 11640/ha and 2.29). The minimum net return and BC ratio were recorded in farmers practice (Rs. 5420/ha and 1.54). This might be due to lower seed yield registered by this treatment.

Conclusion

From the study it could be concluded that adoption of improved management practices *fb* TNAU Microbial consortia spray on paddy stubbles immediately after harvest *fb* irrigation with mobile sprinkler at 30 and 45 DAS could be recommended for getting higher productivity of black gram under rice fallow condition.

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