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RESEARCH ARTICLE

Performance of Little Millet under Rice Fallow Condition

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ABSTRACT

A field experiment was conducted at the wetland farm of Tamil Nadu Agricultural University, Coimbatore, from January to April 2019 to study the profit improvement in rice-based cropping system with little millet under rice fallow condition. The experiment was laid out in a split-plot design with the treatments under Main plot *viz.,* M_1 - Sowing next day after harvest, M_2 - Sowing 15 days after harvest and under subplot four nutrient levels N_1 -0 %, N_2 -50 %, N_3 -75 % and N_4-100 % of RDF replicated thrice. The results revealed that sowing 15 days after rice harvest combined with 100 % RDF recorded better growth, yield parameter, and yield in rice fallow little millet. However, sowing 15 days after rice harvest combined with 75 % RDF was on par with sowing 15 days after rice harvest combined with 100 % RDF.

Keywords: Little millet, date of sowing, nutrient management, rice fallow crop.

INTRODUCTION

Little millet *(Panicum sumatrense L.)* is one of the minor millets, which belongs to the family Poaceae. It is described as a quick-growing, short-duration cereal which withstands both drought and waterlogging (Anon, 1979-1984). The grains of small millets, being nutritionally superior to rice and wheat, provide cheap proteins, minerals and vitamins to the poorest of the poor where the need for such ingredients is the maximum. Small millets in India occupy 4.5 per cent of the cultivated area and are confining to vast stretches of drylands and hilly tracks. It will yield some grain and useful fodder under very poor conditions.

The lower productivity of small millets is mainly due to reduced fertility of soils and non-adoption of an improved package of cultivation. Nevertheless, these crops do have considerable hidden production potential, which could be exploited by a judicial blending of varietal, production, and protection technologies. These crops respond very well even to small doses of inorganic fertilizers and other crop management inputs, which do not involve additional expenditure, such as sowing at the optimum time, maintenance of adequate plant stand, timely weeding, and inter cultivation.

It is necessary to find out the optimum period of sowing for little millet in the summer season as rice fallow crop for obtaining higher production. Among several factors responsible for low yields of little millet crops in India, weed infestation is considered one of the significant factors. Little millet often suffers severe weed competition, especially during early growth phases. Being a short duration and initially slow-growing, little millet 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. It needs more attention to control weeds during summer as it grows more vigorously due to more sunshine and irrigation.

Nitrogen is of vital importance to the physiology of little millet. It plays a critical role in the process of photosynthesis by which plants manufacture their own food from sunlight. Further, nitrogen is essential in little millet for the manufacturing of proteins and virtually every other aspect of its physiology. In addition, phosphorus is an essential nutrient for animals and plants. It plays a critical role in cell development and is a critical component of molecules that store energy, such as ATP (adenosine triphosphate), DNA and lipids (fats and oils). Insufficient phosphorus in the soil can result in a decreased crop yield. However, experimental results indicate that the crop responds favourably low fertilizer application. Keeping aforesaid points in view, the present investigation entitled, "Performance of little millet under rice fallow condition" for maxmizing profit with effective utiliztion of available resources was take up.

MATERIAL AND METHODS

The field experiment was conducted in 'B8'

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field of the wetland farm, Tamil Nadu Agricultural University, Coimbatore at 11^0N latitude and 77^0E longitude with an altitude of 426.7 m above MSL during January to April 2019 to study little millet as an alternate crop to pulse in rice fallow condition. The soil of the experimental site was clayey loam in texture with alkaline pH, medium in organic carbon content, low in available nitrogen, medium in available phosphorus, and high in available potassium. The experiment was laid out in a split-plot design with treatments M_1 - Sowing next day after harvest, M_2 - Sowing 15 days after harvest in the main plot and four nutrient levels N_1 -0 %, N_2 -50 %, N_3-75 % and N_4-100 % of RDF(44: 22: 0 NPK kg ha^{-1}) in subplot replicated thrice with a recommended spacing of 25 × 10 cm. Rice crop was raised as bulk without any treatments with the commonly recommended package of practice during rabi 2018. After harvesting rice, glyphosate spray was given in the morning. Then, immediately, little millet (var. Co 4) was sown under zero tillage conditions by dibbling two seeds per hill at a depth of 2 cm with the help of pointed bamboo peg and the same process repeated for next sowing 15 days after the rice harvest. Thinning and gap-filling was done with utmost care at 10 DAS by keeping one seedling/ hill. As per the treatment schedule, NP was applied full dose as basal for all the treatments. The crop was maintained by adopting a recommended package of practices. Need-based plant protection measures were taken up during the crop growth period. The biometric observations on growth, physiological, yield attributes, and yield were recorded and analyzed as per standard statistical procedures.

RESULTS AND DISCUSSION

Plant height

Data on mean plant height (cm) at 20, 40, 60 DAS, and at harvest are given in Table 1. Plant height of little millet Co 4 was not significantly influenced by different dates of sowing after the rice harvest.

Table 1. Effect of different dates of sowing and nutrient management practices on plant height (cm) of rice fallow little millet (summer, 2019)

Treatment	20 DAS			40 DAS			60 DAS			At harvest		
	M	M	Mean	M	M	Mean	M	M	Mean	M	M	Mean
N	19.37	18.44	18.91	39.26	38.45	38.86	99.40	112.50	105.95	107.80	117.80	112.80
N	21.61	22.64	22.13	43.80	41.16	42.48	105.50	118.60	112.05	112.50	121.10	116.80
N	20.38	24.81	22.60	47.58	44.83	46.21	114.80	122.20	118.50	120.20	126.90	123.55
N	23.06	24.87	23.97	45.96	55.88	50.92	120.50	126.70	123.60	128.70	130.50	129.60
Mean	21.11	22.69		44.15	45.08		110.05	120.00		117.30	124.08	

	M	N	M x N	N x M	M	N	M x N	N x M	M	N	M x N	N x M	M	N	M x N	N x M
SEd	0.89	0.89	1.73	1.26	1.15	1.42	2.56	2.01	3.58	5.71	9.63	8.08	3.29	5.59	9.30	7.91
CD (p=0.05)	NS	1.95	NS	NS	NS	3.10	7.22	4.38	NS	12.45	NS	NS	NS	12.18	NS	NS

Main Plot: Date of sowing

M1 : Sowing next day after rice harvest

M2 : Sowing 15 days after rice harvest

Sub plot: Nutrient Management

N : 0 % RDF

N : 50 % RDF

N : 75 % RDF

N : 100 % RDF

The level of different nutrients significantly influenced plant height (Table 1). Taller plants were noted in 100 % RDF (N_4), which was on par with 75 % RDF (N_3) at 20,40,60 DAS and harvest. Shorter plants were noticed in 0 % RDF (N_1). The increased application of NP might have facilitated more availability and absorption of nutrients. Fertilizer provides sufficient nutrients to plant, which leads to anatomical changes such as an increase in the size of cells, intercellular spaces, thinner cell walls, and lower development of epidermal tissue in increasing increased plant height. Nitrogen promotes vegetative growth, thus, leading to a significant increase in plant height. The above results were similar to an experiment performed by Rathore *et al.,* (2006) in pearl millet where maximum height was observed in 100:30:40 kg NPK/ha. Phosphorus enhances the early root development, which provided a better absorption of nutrients and resulted in overall growth. Sunitha *et al.* (2004), Deshmukh (2007) and Pradhan *et al.* (2011) reported similar findings. Interaction between the date of sowing after rice harvest and fertilizer levels has no notable difference in plant height of little millet.

Dry matter production

The result of dry matter production is presented in Table 2. Different dates of sowing after the rice harvest did not significantly influence the DMP of little millet.

Table 2. Effect of different dates of sowing and nutrient management practices on dry matter production (kg/ha) of rice fallow little millet (summer, 2019)

Treatment	20 DAS			40 DAS			60 DAS			At harvest		
	M	M	Mean	M	M	Mean	M	M	Mean	M	M	Mean
N	2006	2008	2007	3902	3984	3943	4984	5039	5012	5871	5942	5907
N	2029	2037	2033	4014	4027	4021	5210	5385	5298	6008	6023	6016
N	2084	2071	2078	4148	4202	4175	5542	5712	5627	6258	6458	6358
N	2091	2098	2095	4392	4412	4402	5863	5947	5905	6549	6674	6612
Mean	2053	2054		4114	4156		5400	5521		6172	6274	

	M	N	M x N	N x M	M	N	M x N	N x M	M	N	M x N	N x M	M	N	M x N	N x M
SEd	53	77	133	109	133	195	335	276	152	294	479	415	230	222	436	314
CD (p=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	640	NS	NS	NS	483	NS	NS

Main Plot: Date of sowing

M1 : Sowing next day after rice harvest

M2 : Sowing 15 days after rice harvest

Sub plot: Nutrient Management

N : 0 % RDF

N : 50 % RDF

N : 75 % RDF

N : 100 % RDF

The level of different nutrients significantly influenced the DMP at 60 DAS and harvest. Higher DMP was noted in 100 % RDF (N_4), which was on par with 75 % RDF (N_3) at 60 DAS and harvest. Lesser DMP was recorded in 0 % RDF (N_1). There was no significant difference at 20 and 40 DAS in different graded levels of fertilizer application. This might be due to greater availability of applied and residual nutrients, which perhaps enabled the plant to grow tall and produce superior growth parameters as in result, increased DMP. Interaction between the date of sowing after rice harvest and fertilizer levels has no notable difference in dry matter production of little millet.

Table 3. Effect of different dates of sowing and nutrient management practices on yield attributes of rice fallow little millet (summer, 2019)

Treatment	Total Number of tillers/plant			Number of productive tillers/plant			Number of grains/panicle			Test weight of grain(g)		
	M	M	Mean	M	M	Mean	M	M	Mean	M	M	Mean
N	6.0	7.0	6.5	5.0	5.0	5.0	230	231	231	2.30	2.31	2.31
N	7.0	8.0	7.5	6.0	6.0	6.0	234	238	236	2.32	2.37	2.35
N	8.0	8.0	8.0	7.0	7.0	7.0	239	240	240	2.36	2.39	2.38
N	8.0	9.0	8.5	7.0	8.0	7.5	245	249	247	2.39	2.40	2.40
Mean	7.3	8.0		6.3	6.5		237	240		2.34	2.37	

	M	N	M x N	N x M	M	N	M x N	N x M	M	N	M x N	N x M	M	N	M x N	N x M
SEd	0.2	0.3	0.5	0.4	0.3	0.3	0.6	0.4	8	8	16	12	0.08	0.06	0.13	0.08
CD (p=0.05)	NS	0.6	NS	NS	NS	0.7	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Main Plot: Date of sowing

M1 : Sowing next day after rice harvest

M2 : Sowing 15 days after rice harvest

Sub plot: Nutrient Management

N : 0 % RDF

N : 50 % RDF

N : 75 % RDF

N : 100 % RDF

Yield attributes

The result of yield attributes is presented in Table 3 and Figure 1. The number of grains panicle^{-1} and 1000-grain weight, was not significantly influenced by date of sowing after the rice harvest or graded doses of fertilizers and interaction between the date of sowing after the rice harvest and graded doses of fertilizers. Different date of sowing after the rice harvest did not significantly influence on the total number of tillers/plant and number of productive tillers/plant.

Graded doses of fertilizers significantly influenced the total number of tillers/plant and number of productive tillers/plant. The higher total number of tillers/plant and the number of productive tillers/plant were noted in 100 % RDF (N_4), which was on par with 75 % RDF (N_3). Lesser number of total tillers/plant and number of productive tillers/plant was recorded in 0 % RDF (N_1). As we supply the plants with nitrogen, it promotes tiller formation and determines the potential number of tillers. The number of tillers increases with an increase in nitrogen fertilization, and the response, is linear.

The increase in the number of tillers might be due to the availability of nitrogen, which plays a vital role in cell division. This might be due to the luxuriant availability of nutrients for the growth and development of auxiliary bud from which tillers have emerged. These results are in confirmation with the findings of Sunitha *et al*. (2004), Deshmukh (2007), and Pradhan *et al*. (2011). Interaction between the date of sowing after rice harvest and fertilizer levels has no notable difference in yield attribute of little millet.

Table 4. Effect of different dates of sowing and nutrient management practices on grain and strover yield (kg ha^{-1}) of rice fallow little millet (summer, 2019)

Treatment	Grain yield (kg ha^{-1})			Strover yield (kg ha^{-1})		
	M	M	Mean	M	M	Mean
N	1098	1127	1113	3854	3987	3921
N	1278	1378	1328	4094	4120	4107
N	1427	1523	1475	4347	4546	4447
N	1597	1617	1607	4658	4721	4690
Mean	1350	1411		4238	4344	

	M	N	M x N	N x M	M	N	M x N	N x M
SEd	64	72	133	101	116	136	248	192
CD (p=0.05)	NS	156	NS	NS	NS	295	NS	NS

Main Plot: Date of sowing
M1 : Sowing next day after rice harvest
M2 : Sowing 15 days after rice harvest

Sub plot: Nutrient Management
N : 0 % RDF
N : 50 % RDF
N : 75 % RDF
N : 100 % RDF

Yield

The data on grain yield as influenced by graded doses of fertilizer are presented in Table 4, and Figure 2. Grain and straw yield of little millet was not significantly affected by the different date of sowing after the rice harvest.

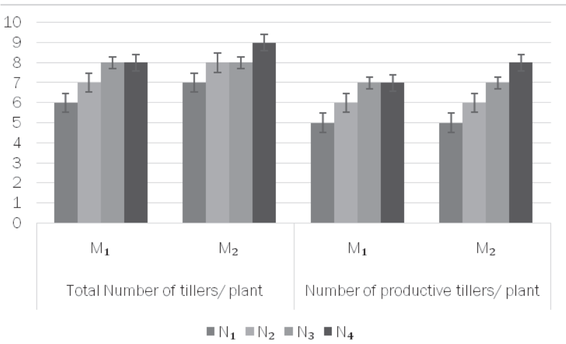

Figure 1. Effect of different dates of sowing and nutrient management practices on yield attributes of rice fallow little millet (summer, 2019)

The level of different nutrients significantly influenced the grain and straw yield. Higher grain and straw yield was noted in 100 % RDF (N_4), which was on par with 75 % RDF (N_3). Lesser grain and straw yield was recorded in 0 % RDF (N_1). Higher grain yield in N_4 could be attributed to the favourable effect of more number of effective tillers. The balanced supply of NPK might have increased all the growth parameters, yield attributing characters, which ultimately contributed to an increase in yields. Nitrogen nutrition increased LAI, chlorophyll content, and nutrient uptake. Phosphorus supply increases cytokinin synthesis and the supply of photosynthates for flower formation. Ultimately, it increases the grain yield. The application of P, in combination with N, contributed to translocate dry matter and physiological attributes towards yield. This might be due to high chlorophyll synthesis and dehydrogenase activity; also it affects source to sink relationship, which reflects in higher yields. Kumar *et al.* (2003), Deshmukh (2007) and Pradhan *et al.* (2011), Bhomte (2013), and Anonymous (2015) observed similar results.

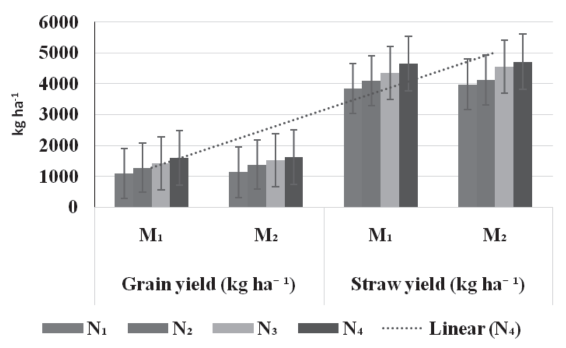

Figure 2. Effect of different dates of sowing and nutrient management practices on grain and strover yield (kg ha^{-1}) rice fallow little millet (summer, 2019)

Interaction between the date of sowing after rice harvest and fertilizer levels has no notable difference in grain and strover yield of little millet.

CONCLUSION

Being an underutilized crop, the little millet performed well in rice fallow condition and responded significantly to the different levels of nutrients. From the present investigation, it is concluded that the application of 100 % RDF, which was on par with

75 % RDF is an efficient and advisable treatment for increasing production with higher grain yield along with high monetary returns in rice-based cropping system as rice-fallow crop. Hence, it is concluded that little millet as rice-fallow crop in the summer season could give a perceived increase in income by efficiently utilizing applied nutrient and residual resources.

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