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RESEARCH ARTICLE

Performance of Little Millet (*Panicum sumatrense*) Varieties Under Different Fertility Level in Rainfed Conditions of Uttarakhand Hills

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ABSTRACT

A field experiment on little millet was conducted during *kharif* season (June-October)of 2020–21 at College of Forestry, V.C.S.G. Uttarakhand University of Horticulture and Forestry, Ranichauri, Tehri Garhwal, Uttarakhand, India to study the effect of fertility levels on different high yielding cultivars of little millet under rainfed conditions of hills of Uttarakhand. The experiment was consisted of sixteen treatment combinations. The experiment was executed in split plot design along with three replications. The different levels of fertility viz. control (without RDF), 50% RDF, 100% RDF and 150% RDF were laid out in main plots, while four cultivars of little millet *viz.* LMV 528, LMV 536, BL 9 and JK 8 were laid out in sub plot. It was observed that little millet crop can be grown successfully in the mid hills of Uttarakhand. The significantly higher grain and straw yield was recorded in 150% RDF than 100% and 50% RDF. Higher B:C ratio was also recorded in 150% RDF. Among the tested varieties LMV 528 recorded significantly higher grain and straw yield along with maximum harvest index. Though crop can be grown successfully in mid hills but it was not economical viable as B: C ratio is lower. Therefore, there is need to develop location specific package of practices to make crop more economical for farmers.

HIGHLIGHTS

- The little millet is not the traditional crop of hills of Uttarakhand but it can be grown successfully in rainfed hilly area.
- The little millet variety LMV 528 with 150% of RDF(40:20:0 kg ha^{-1} $N:P_2O_5:K_2O$) performed better under rainfed conditions of Uttarakhand hills.

Keywords: Little millet, minor millet, nutri-cereals, nutrient management, small-millet

Minor millets are gaining importance in Indian agriculture due to the their huge potential to provide security of food (Muthamilarasan and Prasad 2021), nutrition (Kumar *et al*. 2018), fodder, health (Pujari and Hoskeri 2022; Dayakar *et al*. 2017; Bhat *et al*. 2018), livelihood (Finnis, 2012) and ecology (Brahmachari *et al*. 2019). Minor millet is well adapted to dryland/ rainfed, aberrant weather and input conditions. Because of all these qualities, millets are called as Miracle Grains/ Nutri-Cereals (Gowri and Shivakumar,

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2020).The minor millets comprise of proso millet (*Panicum miliaceum*), foxtail millet (*Setaria italica)*, little millet (*Panicum sumatrense*), barnyard millet (*Echinochloa frumentacea)* and kodo millet (*Paspalum scrobiculatum*).Little millet is commonly termed as *vari*,*sava* and *halvi* in Marathi,*sama*in Bengali, *samai* in Tamil, *kutki*, *shavan* in Hindi, *Gujro* and *kuri* in Gujarati, *same* and *saave*inKannada etc. (Bhat *et al*. 2019). It can be consumed as rice and flour which can be used to prepare baked foods. It is rich in minerals and vitamins compared to rice and wheat. The little millet contains 8.7 g protein, 75.7 g carbohydrate, 5.3 g fat, 8.6 g crude finder, 1.7 g mineral, 9.3 mg iron, 17 mg calcium, 220 mg phosphorus and 3.5 mg zinc in 100 gram grain (Louhar *et al*. 2020; Bhat *et al*. 2018; Veena *et al*. 2005). The high dietary fiber content of little millet induces a lower glycemic response and slow digestion of starch (Jhawer, 2017; Patil *et al*. 2015). The sulphur-containing amino acids *viz.* cysteine and methionine are abundant in little millet than the most cereals (Neeharika *et al*. 2020; Maitra 2019). Little millet also has higher amount of hydroxycinnamic acid (173 $\mu g g^{-1}$) (Kumar *et al*. 2018), carotenoid (78–366 $mg100g^{-1}$) and tocopherol (1.3–4.0 $mg100\ g^{-1}$) (Dykes and Rooney 2006). It is mainly grown for food grain and good quality fodder, especially in tribal areas of Karnataka, Madhya Pradesh, Chhatisgarh, Andhra Pradesh, and Tamil Nadu (Anonymous 2020). In Uttarakhand among the millets, finger and barnyard milletsare main crops which are mainly grown in *kharif* season. The cultivation of little millet has not been reported from Uttarakhand. As Uttarakhand is important millet growing state, little millet cultivation helps in diversification of *kharif* crops and able to utilize the potential of rainfed areas. The poor adoption of millets by farmers is mainly due to poor productivity of these crops (Bana *et al*. 2013; Adekunle *et al*. 2012) and consequently poor economic returns. Stresses like nutrient and moisture are adversely affecting millet productivity (Mubeena *et al*. 2019). These crops are mainly being cultivated in rainfed regions and the average crop yield levels of these agro-ecologies are 3–4 folds lower than the potential (Bamboriya *et al*. 2017). The millet cultivation can be making remunerative through achieving the higher productivity of these crops. The selection of suitable little millet variety and fertilizer dose are required to grow the crop successfully with higher productivity in rainfed hills of Uttarakhand. The improved varieties and appropriate fertilizer use could improve little millet yields of rainfed Uttarakhand hills. Higher millet yields in rainfed regions can be realized through efficient nutrient management approaches (Bana *et al*. 2018; Chander *et al*. 2013). Hence, there is need to evaluate different varieties under rainfed *Garhwal* conditions for its suitability along with optimum fertilization schedules for achieving its potential yield.

MATERIALS AND METHODS

A field experiment was conducted at the Research and Extension Centre, Gaja, College of Forestry of VCSG Uttarakhand University of Horticulture and Forestry, Ranichauri, Tehri Garhwal, Uttarakhand, India during *kharif* season (June-October) of 2020 to select the suitable fertilizer dose and high yield varieties of little millet under rainfed condition of hilly Uttarakhand. The soil was silty clay loam of medium depth with acidic pH (5.8) having 0.78% organic carbon, 220kg ha^{-1} available N, 18.16 $kgha^{-1}$ available P and 410kg ha^{-1} available K. The experimental site was situated at 1754 m above mean sea level. The climate of the experimental site was humid and temperate type with chilled winter. The total precipitation during the crop season was recorded 641.0 mm in 2020, whereas the maximum temperature varied between 20.5–24.9°C during cropping season. Similarly, minimum temperature varied between 6.9 and 14.7°C during *kharif* season of 2020–2021. The experiment was having twelve treatment combinations consisting of three fertility levels *viz.* control (without RDF), 50% recommended dose of fertilizer (RDF), 100% RDF and 150% RDF in main plot and four varieties namely LMV 528, LMV 536, BL 6 and JK 8 in subplots arranged in split plot design along with three replications. The crop was sown in lines of 25 cm apart with plant to plant distance of 7.5 cm on 26th June, 2020 and harvested as per maturity. The crop was raised using standard package and practices. The crop was fertilized with RDF $N:P_2O_5:K_2O$ @ 40:20:0 kg ha^{-1} using Urea and DAP. The plant height, number of productive tillers per plant, days to 50% flowering, days to maturity, grain yield and straw yield were recorded by using standard procedure. The cost of cultivation and economic return were calculated on the basis of present market price of inputs and

outputs. The data was statistically analyzed using STPR-1 designed by Department of Mathematics and Statistics of GBPUA&T, Pantnagar.

RESULTS AND DISCUSSION

The plant height of little millet was not significantly influenced by the fertility levels and different varieties. The plant height was recorded maximum in LMV 528 and minimum in BL 6. Plant height of little millet was increased with the increase of fertility level. Maximum plant height was recorded in 150% recommended dose of fertilizer and minimum was recorded in case of control (without RDF).Similar results were also reported in little millet. The interaction of fertilizer dose and variety was also recorded non significant in case of plant height of little millet. The maximum number of productive tillers plant^{-1} was recorded in LMV 528. The lowest productive tillers plant^{-1} was recorded in BL 6. The interaction of fertilizer dose and variety of little millet was found non-significant in case of number of tillers plant^{-1}. Tillers plant^{-1} were higher due to higher availability of nutrients for growth and development of auxiliary buds from which tillers were emerged. The days to 50% flowering were recorded maximum in LMV 528 while minimum in JK 8. The JK 8 cultivar was recorded 14 days early flowering than the LMV 528. Days to 50% flowering was not affected by the fertility levels. Similarly maturity was also recorded early in case of JK 8 than the LMV528. JK8 registered 13 days early maturity than the LMV 528. Fertility levels did not affect the maturity period. The test weight of little millet was significantly influenced by the fertilizer application and varieties. The test weight increased significantly when fertilizer level increased from control (without RDF) to 50% RDF but there was not significant increase when fertilizer increased from 50–150% RDF. The maximum test weight was recorded in LMV 528 which was significantly higher than other tested varieties due to better source-sink relationship. The application of 50–100% RDF resulted better growth parameters such as plant height, number of tillers plant^{-1} and 1000 grain weight because nitrogen and phosphorus having beneficial effects of on growth and yield contributing character (Mubeena *et al.* 2019). Nigade and More (2013) also reported that application of RDF increased the concentration of nutrient ions in the soil solution and availability of sufficient nutrients might have helped in higher nutrient uptake in finger millet.

Table 1: Effect of different levels of fertilizer on yield of little millet varieties

Treatments	Plant height (cm)	Number of productive tillers plant^{-1}	Days to 50 % flowering	Days to maturity	1000 grain weight (g)	Yield		Harvest Index (%)	Cost of Cultivation (₹ ha^{-1})	Gross Return (₹ ha^{-1})	Net Return (₹ ha^{-1})	B:C Ratio
						Grain (kg ha^{-1})	Straw (kg ha^{-1})					
Fertilizer level												
Control	76.90	2.17	100.25	137.50	2.33	244	2395	9.18	14320	12081.2	-2238.8	-0.16
50 % RDF	82.00	2.39	100.25	137.50	2.36	326	2721	10.54	14799	14940.5	141.5	0.01
100% RDF	85.11	2.58	100.25	137.50	2.37	472	3505	11.90	15811	20561.2	4750.2	0.30
150% RDF	85.32	2.64	100.25	137.50	2.37	513	3980	11.49	16823	22782.7	5959.7	0.35
SEm±	2.14	0.15			0.009	11	76					
CD (p=0.05)	NS	NS			0.03	36	263					
Varieties												
LMV 528	89.54	2.61	108	144	2.42	506	3551	12.52	15438	21527.5	6089.5	0.39
LMV 536	77.83	2.36	98	136	2.33	381	2974	11.04	15438	16960.0	1522.0	0.10
BL 6	76.35	2.25	101	139	2.31	291	2858	9.27	15438	14420.0	-1018.0	-0.07
JK 8	85.61	2.56	94	131	2.36	377	3219	10.28	15438	17472.5	2034.5	0.13
SEm±	1.62	0.1			0.007	14	112					
CD (p=0.05)	NS	NS			0.02	41	327					
Interaction (F×V)												
CD (p=0.05)	NS	NS			NS	NS	NS					

Among the tested varieties of little millet, maximum grain yield (506kg ha^{-1}) was recorded with LMV 528 which was significantly superior over the other tested varieties which is shown in Table 1. The grain yield of LMV528 was 73.8% higher than BL 6. The lowest grain yield (291kg ha^{-1}) was observed in BL 6. The maximum straw yield was also observed with variety LMV 528 as compare to other tested varieties and minimum straw yield was recorded in BL 6. Fertilizer level influence grain and straw yield significantly. Application of 150% recommended dose gave higher grain yield (513kg ha^{-1}) and straw yield (3980kg ha^{-1}) than the 100% RDF. The significant increase in seed yield in LMV 528 variety at 150% fertility levels was due to higher plant growth i.e. plant height and yield attributing characters like number of productive tillerplant^{-1}, 1000 grain weight and harvest index. It also reported highest yield of little millet yield with 40 kg ha^{-1}nitrogen and 20 kg ha^{-1} potassium under rainfed condition of Karnataka. The balance application of nitrogen and phosphorus lead to better growth of little millet. This may be due to increased vegetative growth and capacity to produce more number of tillers under higher nitrogen levels (Louhar *et al.* 2020; Harika *et al.* 2019). The maximum net return (6089 ha^{-1}) was recorded in LMV 528 and lowest net return was recorded in case of BL 6 (-1018 ha^{-1}). It was only because of higher grain and straw yield of the variety as cost of cultivation was same with the all varieties as represented in Table 1. It also resulted in higher B:C ratio (0.39) with the cultivation of LMV 528. Among the fertility level maximum B:C ratio was observed at 150% RDF (0.35) due to higher gross and net return. The B:C ratio of little millet cultivation was recorded lower in rainfed conditions of Uttarakhand hills therefore there is need to develop improve package of practices to make crop more remunerative.

CONCLUSION

LMV 528 cultivar of little millet could be grown successfully in Uttarakhand hills with the application of 150% of the existing recommended dose of fertilizers (40:20:0 kg ha^{-1} N:P_2O_5:K_2O). Though crop could be grown successfully in mid hills but it is not economical viable as B:C ratio is lower and not sustainable. Therefore there is need to develop location specific package of practices to make crop more economical for farmers.

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