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Little millet (*Panicum sumatrense*) response to different fertility levels and seed rates under rainfed condition of Chhattisgarh

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Abstract
The present investigation was conducted at Potato and Temperate Fruit Research Station, Mainpat, Surguja, Chhattisgarh during 2022 *kharif* season. The experiment was based on the design of split plot design with three replications. The treatments comprised of three seedrates *viz.*4 kg ha^{-1}(S_1), 6 kg ha^{-1} (S_2) and 8 kg ha^{-1} (S_3) as main-plot treatment and three fertility levels *viz.* Control (F_1), 20:10:05 kg NPK ha^{-1} (F_2) and 30:20:10 kg NPK ha^{-1} (F_3) as sub-plot treatment. Sowing was done at the row to row spacing of 22 cm. Results showed that growth parameters *viz.* number of tillers plant^{-1}, number of leaves plant^{-1}, dry matter accumulation and all yield attributing characters were the highest under 4 kg seed rate ha^{-1} (S_1), but plant height was found higher with 8 kg seed rate ha^{-1} (S_3) as compared to 6 kg ha^{-1} seed rate (S_2) and 4 kg ha^{-1} seed rate (S_1).While 8 kg seed rate ha^{-1} (S_3), gave the highest grain yield (10.34 q ha^{-1}), straw yield (37.52 q ha^{-1}) and net return returns (₹ 21763 ha^{-1}) than 6 kg seed rate ha^{-1} (S_2) and 4 kg seed rate ha^{-1} (S_1). Among the different fertility levels, application of 30:20:10 kg NPK ha^{-1} (F_3), was found superior over 20:10:05 kg NPK ha^{-1} (F_2) and 0:0:0 kg NPK ha^{-1} (F_1) with respect to growth performance and yield attributes which produced significantly highest grain yield (11.13 q ha^{-1}), straw yield (29.17 q ha^{-1}), net return (₹ 23074 ha^{-1}) and B:C ratio (1.45).

Keywords: Little millet, seed rates, fertility levels, yield, economics

Introduction
Little millet (*Panicum sumatrense*) 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., 1984). Millets is considered as 'nutricereals' crop and each 100 g little millet grain contains 65.5 g carbohydrate, 10.1 g protein, 3.89 g fat, 346 Kcal energy, 7.7 g dietary fiber, 16.1 mg calcium, 130 mg phosphorus, 91 mg magnesium, 1.8 mg zinc, 1.2 mg iron, 0.26 mg thiamin, 0.05 mg riboflavin, 1.3 mg niacin and 362µg folic acid (Venkatesh *et al.*, 2018) [12]. Little millet is one among the six small millets grown in most of the regions of scanty and erratic rainfall on poor and marginal soils. Cultivation of this crop is mostly confined to hilly tract of poor tribal community of the country. The demand for little millet is increasing now-a-days due to its high nutritional profile with low glycemic index particularly by the people suffering from diabetes.
In India small millets cultivated an area of 4.44 lakh ha with total production about 3.47 lakh tones and productivity of 781 kg ha^{-1} (Anonymous, 2021) [1]. The major little millet growing states are Orissa, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh and Chhattisgarh. In Chhattisgarh Small millets occupied an area of 0.85 lakh ha with total production about 0.22 lakh tones and productivity of 258 kg ha^{-1} (Anonymous, 2021b) [2]. Poor soil fertility and erratic rains are the most important constraints to millets production in the rainfed ecosystem. Nitrogen, phosphorus and potassium are the essential elements required for plant growth in relatively large amounts for better performance in crop growth (Dhhwayo and Whhgwin, 1984) [4]. These crops respond very well even to recommended doses of fertilizers (Sapthagiri *et al.*, 2020) [10].

Materials and Methods
The present experiment was conducted during the *kharif* season of 2022 at the Potato Research Station Mainpat, Surguja, Chhattisgarh. Mainpat is situated in the north of Chhattisgarh and lies between 22^{0}83' N latitude and 83^{0}31' E longitude having an altitude of 1085 meters above

mean sea level. The maximum rainfall recorded during the experimental period was 2023.8 mm (01stWeek of July 2022) to (04th Week of October 2022), respectively. The soil of the experimental field was slightly acidic in nature having pH 6.23. Available nitrogen phosphorus and potash was 204.8, 13.7 and 218.89 kg ha^{-1}, respectively. The experimental trial conducted in split plot design. The treatments consisted of three seed rates *viz*., 4, 6, and 8 kg ha^{-1} and three fertilizer levels *viz*., 0:0:0, 20:10:05, & 30:20:10 kg ha^{-1} N, P_2O_5 and K_2O respectively and replicated three times. The crop was sown on 6th July, 2022. Full quantity of phosphorus, potassium and 75% amount of nitrogen was applied as basal dose simultaneously at the time of seed sowing. Remaining 25% nitrogen was top dressed in 30 DAS. The crop was harvested on 28thOctober, 2022. Observations on growth, yield contributing characters and yields were recorded and analyzed statistically to evaluate the treatment effects on little millet.

Results and Discussion

Effect of Seed Rate

The variable performance of little millet was recorded with different seed rate on growth parameters and yield attributes (Table 1) and yields and economics (Table 2). Seed rate 4 kg ha^{-1} recorded significantly higher number of leaves plant^{-1} (9.11), dry matter accumulation (11.12 g plant^{-1}), length of panicle^{-1} (29.14 cm), number of spikes panicle^{-1} (17.44) number of grains panicle^{-1} (1151.11), grain yield panicle^{-1} (2.52 g), while seed rate 8 kg^{-1} recorded highest plant hight (96.78 cm), grain yield (10.34q ha^{-1}), straw yield (37.52 q ha^{-1}) over rest of the seed rates.

Significantly increase in plant height with the increasing plant densities can be attributed to increased competition between stems for light. Higher grain yield from 8 kg ha^{-1} might be due to increased plant population due to closer spacing, increased number of tillers, LAI and increased the photosynthetic efficiency of crop. Whereas yield attributing characters was higher with 4 kg ha^{-1} seed rate due to vigorous growth, higher fertility of panicles and proper development of grains due to environmental factors such as nutrients, moisture and light. Similar findings were also reported by Deshmukh (2007) [3], Divyashree (2017) [5], Raundal and Patil (2017) [9] and Gani *et al.*, (2018) [6].

Effect of fertility levels

Different fertilizer dose shows remarkable effect on growth parameters and yield attributes (Table 1) and yields and economics (Table 2). Fertility level 30:20:10 NPK kg ha^{-1} ha^{-1} recorded significantly higher plant hight (97.33 cm), number of leaves plant^{-1} (9.89), dry matter accumulation (12.27 g plant^{-1}), length of panicle^{-1} (30.42 cm), number of spikes panicle^{-1} (18.56), number of grains panicle^{-1} (1205), grain yield panicle^{-1} (2.51 g) and grain yield (11.13 q ha^{-1}), straw yield (39.17 q ha^{-1}) over rest of the fertility levels. Fertility levels 30:20:10 NPK kg ha^{-1} (F_3) provides sufficient nutrient to plant which leads to anatomical changes such as increase in size of cells, intercullar spaces, thinner cell walls and lower development of epidermal tissue resulted to increase in plant height. Similar finding were reported by Sunitha *et al*. (2004) [11]. Higher availability of nitrogen and phosphorus at vegetative and reproductive phases enables plants for promotion of cell division and expansion of leaves. Sufficient availability of nitrogen and phosphorus to plants also resulted in higher accumulation of photosynthetic assimilates might be responsible for maximum yield attributes of crop. The results confirm with the finding of Raundal and Patil (2017) [9]. Higher grain yield was obtained by higher dose of fertilizer due to vigorous growth and proper development of grains due to sufficient nutrients, moisture and light. Similar findings also reported by Gani *et al*, (2018) [6] and Divyashree (2017) [5].

Economics

The highest gross return (₹ 36206), net return (₹ 21763) and B:C ratio (1.51) recorded with seed rate 8 kg^{-1} and fertility level 30:20:10 NPK kg ha^{-1} recorded higher gross return (₹38943), net return (₹23074) and B:C ratio (1.45). This might to be due to optimum plant population maintained in a unit area which may leads to higher grain yield resulted in higher values for net return and benefit cost ratio resulted in more profit. Similar finding also reported by Jawahar *et al*. (2018) [7]. Higher levels of nitrogen and phosphorus to plants resulted in higher accumulation of photosynthetic assimilates might be responsible for higher grain yield with good monetary return. Similar results were also reported by Ramamoorthy and Lourduraj (2002) [8] and Sunitha *et al*., (2004) [11].

Table 1: Growth characters and yield attributes of little millet as influenced by seed rates and fertility levels

Treatments	Plant height (cm)	No. of leaves plant^{-1}	Dry matter accumulation (g day^{-1} plant^{-1})	No. of spikes panicle^{-1}	No. of seeds panicle^{-1}	Grain yield panicle^{-1} (g)
Seed rate						
S_1- 4 kg ha^{-1}	92.22	9.11	11.12	17.44	1151.11	2.52
S_2- 6 kg ha^{-1}	93.78	9.00	10.04	16.56	1109.56	2.31
S_3- 8 kg ha^{-1}	96.78	8.56	9.96	15.44	1069.89	2.21
SEm±	0.37	0.16	0.18	0.37	10.22	0.05
CD (P= 0.05%)	1.44	0.62	0.71	1.44	40.13	0.19
Fertility levels (kg ha^{-1})						
F_1- $N_0P_0K_0$	91.33	8.22	8.89	15.11	1021.67	2.15
F_2- $N_{20}P_{10}K_5$	94.11	8.56	9.96	15.78	1103.89	2.38
F_3- $N_{30}P_{20}K_{10}$	97.33	9.89	12.27	18.56	1205.00	2.51
SEm±	0.36	0.23	0.19	0.16	27.47	0.08
CD (P= 0.05%)	1.11	0.70	0.59	0.48	84.63	0.26
Interaction	NS	NS	NS	NS	NS	NS

Table 2: Yields and economics of little millet as influenced by seed rates and fertility levels

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B: C ratio
Seed rate					
S_1- 4 kg ha^{-1}	9.01	30.26	31527	17265	1.18
S_2- 6 kg ha^{-1}	10.21	34.39	35735	21382	1.49
S_3- 8 kg ha^{-1}	10.34	37.52	36206	21763	1.51
SEm±	0.26	1.28	898	898	0.06
CD (P= 0.05%)	1.01	5.02	3526	3526	0.25
Fertility levels (NPK kg ha^{-1})					
F_1- $N_0P_0K_0$	8.19	28.93	28681	16292	1.31
F_2- $N_{20}P_{10}K_5$	10.24	34.08	35844	21045	1.42
F_3-$N_{30}P_{20}K_{10}$	11.13	39.17	38943	23074	1.45
SEm±	0.15	1.88	535	535	0.04
CD (P= 0.05%)	0.47	5.80	1650	1650	0.11
Interaction			S × F		
SEm±	0.26		927	927	0.063
CD (P= 0.05%)	S	NS	S	S	S

Conclusion

According to the thesis' findings, 8 kg ha^{-1} seed rate of little millet may be planted with fertility level 30:20:10 kg NPK per hectare when grown under the current agroclimatic conditions, ensuring a maximum and profitable production.

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