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Effect of age of seedlings and different levels of fertilizers and micro nutrients on economics and B:C ratio of Proso millet grown in Konkan region

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Abstract
A field experiment was conducted to study the "Effect of age of seedlings at transplanting, different nutrient levels and micronutrient on nutrient uptake of proso millet (*Panicum miliaceum* L.) grown during *kharif* season of Konkan region of Maharashtra. Soil was having low to moderate fertility status. The experiment was laid out in split split plot design with three main plot, two sub plot and four sub sub plot treatments. The data revealed that transplanting of proso millet at 30 day old age seedling were obtained that the highest cost of cultivation, gross return, net return and B:C ratio found under the different age of seedling. In fertilizer levels application of 125 per cent of the RDF were significantly higher cost of cultivation, gross return, net return and B:C ratio over the 100 per cent RDF. In cases of different levels of micro-nutrients data reveals that the combined application $ZnSO_4$ and $FeSO_4$ were recorded highest cost of cultivation, gross return, net return and B:C ratio over rest of the treatments.

Keywords: Age of seedling, fertilizer levels, micro-nutrient, nutrient content, nutrient uptake and proso millet

Introduction
A significant group of agronomical crops called millet performs and thrives in rainfed environments. The primary trait of these crops is their suitability in challenging environments. The majority of millet varieties, also referred to as coarse cereals, are produced in India. However, after learning about these grains' nutrient makeup, they are now regarded as nutria cereals (nutritious grains). India produced 4.45 lakh tonnes of small millet in 2014–15 on an area of 9.03 lakh ha under cultivation. The largest area under millets in Maharashtra is in the Konkan region, which includes Raigad, Palghar, Thane, Sindhudurg, and Ratnagiri district, as well as the sub-mountainous Sahyadri region, which includes Kolhapur, Nasik, Satara, Sangali, and Pune districts. Production in Maharashtra in 2005-06 was 9809 thousand tonnes with productivity of 1054 kg ha^{-1}. Additionally, proso millet has some documented therapeutic qualities in Asian nations. It benefits the nervous system, the cardiovascular system, the prevention of pellagra and other niacin-dependent conditions, the bones, the reduction of cholesterol, the risk of cancer, the prevention of gallstones, the treatment of celiac disease, and the prevention of gallstones. In addition to these advantages, it has a lot more. It is especially helpful for post-menopausal women exhibiting heart disease symptoms because it lowers blood pressure and supplies iron, vitamin B6, and zinc, all of which are necessary for day-to-day survival. Proso millet is renowned for having a lot of nutrients. The seeds are a good source of protein (12–13%) and can be stored for a long time in an ambient environment, making them an ideal famine reserve (Ramesh *et al.*, 1998) [6]. It has a lot of lysine, an amino acid that is lacking in most cereals. In addition to protein, it also includes roughly 1.1% crude fat, 68.9% carbs, 2-3% minerals, 2.2% crude fibre, 3.4% ash, and 14 mg of calcium, 206 mg of phosphorous, and 5 mg of iron per 100 grammes (Wanjari *et al.*, 2003) [7]. The quantity and quality of cereals can be increased with the help of fertiliser and micronutrients. In the nation's key crop-growing regions, micronutrient insufficiency is a widespread issue. Micronutrient deficiencies increase as a result of the widespread use of pure fertilisers like urea, SSP, and MOP. Micronutrient zinc is crucial for the healthy growth, development, and wellbeing of plants. A great deal of agricultural land has recently been determined to be zinc deficient, which significantly reduces crop productivity and nutritional value (Chetna Sinha 2016) [1].

Materials and Methods

The present field experiment entitled "Effect of age of seedlings and different macro and micro nutrients on growth, yield and quality of proso millet (*Panicum miliaceum* L.) grown during *kharif* season of Konkan condition", was conducted at Agronomy farm, College of Agriculture, Dapoli, Dist, Ratnagiri (M.S.) *kharif* during a season of 2017. The experimental plot's surface area was level and consistent. The soil in the experimental plot was level and uniform. The soil at the test site had good drainage. Before beginning a field experiment, a composite soil sample from the top 30 cm of the stratum was taken using a screw auger of 170"4' North latitude and 730"1' East longitude, at a height of 250 metres above mean sea level, the agronomy field of the faculty of agriculture in Dapoli, District Ratnagiri, is located in a tropical area. During the Kharif season, the tropical climate's warmth and humidity are ideal for growing crops like millet. Dapoli receives 3026.0 mm of precipitation on average per year, which is spread out from early June to late October.

The experiment were laid out up using a split split plot design with three main plot, two sub plot and four sub sub plot treatments. The three different seedling ages used in the main plot treatments—A_1, A_2 and A_3—were respectively 20, 30 and 40 days old. The four sub sub plot treatments consist of micronutrient *viz*., control, application of zinc sulphate @ 15 kg ha^{-1}, application of ferrous sulphate @ 15 kg ha^{-1} and combination of zinc sulphate and ferrous sulphate *i.e*., M_1, M_2, M_3 and M_4, respectively. The two sub plot treatments consisted of different types of nutrient combinations, namely 100% RDF and 125% RDF. As a result, the net plot size was 3.2 m x 2.9 m and the gross plot size was 3.6 m x 3.2 m, respectively. By using the thomba method and a spacing of 20 cm x 15 cm, proso millet variety vari no-10 was transplanted. The recommended fertiliser dosage (RDF) for each hectare was 80:40:00 kg NPK. Following advice from an experiment, the necessary cultural practises and plant protection measures were implemented.

Results and Discussion

Effect of age of seedlings

Transplanting of proso millet at 30 days old seedling gave the maximum monetary benefits *i.e*. net returns and shows highest benefit cost ratio (Table 1) as compared to other treatments where crop was transplanted at 20 and 40 days old age seedling. Proso millet transplanted at 30 day old age seedling yielded more grain and straw than other sowing times, which contributed significantly to the enhanced net returns and benefit: cost ratio. These outcomes are consistent with Aggarwal and Singh (2015) [1] and Kakad (2017) [4].

Effect of Fertiliser levels

The fertilizer application with 125 per cent of RDF to proso millet gave the highest gross returns, and benefit to cost ratio (Table 1) recommended dose of fertilizer. Among two fertilizer levels 125 per cent of RDF dose was found to be more economically and profitable as its B:C ratio was 0.85 and the lowest B:C ratio recorded under where fertilizer application is as per recommended dose *i.e*. 0.79. The enhanced grain and straw yield under 125 per cent of RDF level of fertiliser was the primary cause of the increased gross returns and benefit: cost ratio. Nigade and More (2013) [5] and Kakad *et al*. (2021) [3] reported similar outcomes as well.

Effect of Micro-nutrients levels

Proso millet fertilized with micronutrient combination gave the maximum monetary benefits and shows highest benefit: cost ratio (Table 1) as compare to other treatments where crop was fertilized with sole application of micronutrients. Proso millet fertilised with a combination of micronutrients produced more grain and straw than other applications, which contributed significantly to the higher net returns and benefit cost ratio.

Economics of treatment combinations

The data on economics of treatment combinations are presented in Table 2. Data revealed that the maximum and highest B:C ratio 0.98 was observed when proso millet established by transplanting, at 30 days age old seedling with 125 per cent of RDF along with the micronutrient combination of zinc and ferrous sulphate @ 15 kg ha^{-1}. Kakad *et al*. (2021) [3] reported similar outcomes as well.

Table 1: Data regarding Economics of the proso millet cultivation as influenced by different treatment

Treatments	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio (₹ ha^{-1})
A) Age of seedlings				
A_1: 20 days old seedlings	52551.22	42964.80	-9586.43	0.81
A_2: 30 days old seedlings	53707.51	49902.51	-3805.00	0.93
A_3: 40 days old seedlings	51871.72	38887.76	12983.96	0.75
B) Fertilizer Levels				
N_1: 100% RDF	51892.09	41945.72	-9946.37	0.80
N_2:125% RDF	53528.21	45890.99	-7637.23	0.85
C) Effect of Micronutrients				
M_1: Control	50104.76	39383.52	-10721.24	0.78
M_2: Zinc Sulphate @ 15 kg/ha	53355.45	43937.74	-9417.71	0.82
M_3: Ferrous sulphate @1 kg/ha	52344.14	42167.74	10176.40	0.80
M_4: Combination of$ZnSO_4$ and $FeSO_4$	55036.25	50184.42	-4851.83	0.91
General mean	52710.15	43918.35	-88791.79	0.82

Table 2: Data regarding Economics of the proso millet as affected by different treatment combination

Treatment combinations	Total cost (₹ ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B : C Ratio
$A_1N_1M_1$	48317	31593	-16723.9	0.65
$A_1N_1M_2$	51349	34834	-16514.8	0.68
$A_1N_1M_3$	50776	35695	-15080.8	0.70
$A_1N_1M_4$	53732	45293	-8438.99	0.84
$A_1N_2M_1$	51687	45940	-5747.07	0.89
$A_1N_2M_2$	54407	47312	-7095.03	0.87
$A_1N_2M_3$	54064	49553	-4511.53	0.92
$A_1N_2M_4$	56078	53499	-2579.17	0.95
$A_2N_1M_1$	50986	47605	-3380.53	0.93
$A_2N_1M_2$	57590	54113	-3477.00	0.94
$A_2N_1M_3$	54186	51156	-3029.57	0.94
$A_2N_1M_4$	60470	58012	-2457.97	0.96
$A_2N_2M_1$	50269	37435	-12834.70	0.74
$A_2N_2M_2$	54833	49868	-4965.30	0.91
$A_2N_2M_3$	53620	46887	-6732.80	0.87
$A_2N_2M_4$	55353	54144	-1208.73	0.98
$A_3N_1M_1$	49628	39461	-10167.2	0.79
$A_3N_1M_2$	50918	32246	-18671.4	0.63
$A_3N_1M_3$	50246	32517	-17729.4	0.65
$A_3N_1M_4$	52987	40823	-12164.1	0.77
$A_3N_2M_1$	49741	34268	-15473.8	0.68
$A_3N_2M_2$	54064	45253	-8810.97	0.84
$A_3N_2M_3$	52005	37198	-14807.2	0.72
$A_3N_2M_4$	55384	49336	-6047.87	0.89

Conclusion

Transplanting of proso millet at 30 days old seedling with 125 per cent of RDF along with Micronutrient combination of ferrous and zinc sulphate recorded the higher B:C ratio over rest of the treatments under study.

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