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Effect of seedling age and different levels of fertilizer on growth and yield of transplanted finger millet (*Eleusine coracana* L.)

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Abstract
The experiment was carried out for the evaluation of seedling age and different levels of fertilizer on growth and yield of transplanted finger millet Co (Ra) 15 during *rabi* season of 2019-2020 at Agricultural College and Research Institute, Killikulam. The experiment was laid in split plot design and replicated thrice. The main plot consists of different age of seedlings *viz*., 15, 18 and 21 days old seedlings raised with nutrient media. Simultaneously 17 days old seedlings also raised as conventional method. In subplot different levels of recommended fertilizer dose *viz*., 75, 100 and 125% were imposed. During the cropping, various plant growth characters such as plant height and drymatter production were recorded at harvest stage and number of tillers hill^{-1} was recorded at 60 DAT. The yield characters like number of productive tillers, number of earheads m^{-2}, Number of filled grains earhead^{-1}, grain and straw yield were also recorded. The experimental result shows that planting 15 days old seedlings from nutrient media along with application of 125% RDF recorded significantly higher plant height (108.5 cm), number of tillers hill^{-1} (8.9), drymatter production (9524 kg ha^{-1}), number of productive tillers hill^{-1} (6.9), number of earheads m^{-2} (153), number of filled grains earhead^{-1} (1696), grain (3602 kg ha^{-1}) and straw yield (6484 kg ha^{-1}) and it was on par with15 days old seedlings from nutrient media along with 100% RDF.

Keywords: Finger millet, age of seedlings, fertilizer levels, growth and yield

Introduction
Finger millet is an important small millet crop in India belongs to the family Poaceae. It is commonly called "Ragi" in India and "Keezhvaragu" in Tamil Nadu. It adds stable diet in human dietary by supplying more health-beneficent nutrients such as carbohydrate, protein, vitamins, fat, crude fibre, calcium, phosphorus, iron, manganese and magnesium compared to other cereals and millets and hence it is called as "nutritious millet" at all over the world (NRC, 1996) [14]. The germinated grains contains higher protein, essential amino acid, vitamin A & B and phosphorus, etc., and had benefits to the pregnant women and children (Gopalan *et al.*, 2004) [7]. In India, it occupies the sixth position in production and productivity from the cultivated area of 8.9 lakh hectare with the production and productivity of 12.39 lakh tones and 1390 kg ha^{-1}, respectively. In Tamil Nadu, the cultivable area under finger millet was 0.79 lakh hectares with a production and productivity of 2.5 lakh tones and 3257 kg ha^{-1}, respectively during 2018-2019 (Indiastat, 2019) [9].

The productivity of finger millet was registered at low estimates due to transplanting of aged seedlings and improper cultivation practices. In earlier days, the farmers were used their local land races which were long duration and less affected by age of seedling. A number of semi-dwarf and medium-duration finger millet varieties were evolved and they should be transplanted at the optimum age of seedling for the better return. Transplanting optimum age of seedling produce healthy and vigorous seedlings. Planting of early-stage seedlings and application of the appropriate amount of chemical fertilizers might improve the vegetative growth of the plant, quality of grain and crop yield (Ahiwale *et al.*, 2011) [3]. Thus, an attempt was made to find out the effect of age of seedlings produced under different soil media along with levels of nutrients on growth and yield of transplanted finger millet (*Eleusine coracana* L.).

Materials and Methods

The field experiment was conducted at Agricultural College and Research Institute, Killikulam during *rabi* season of 2019-2020. Finger millet Co (Ra) 15 variety was used for this experiment to ascertain the effect of age of seedlings and different levels of fertilizer on growth and yield of transplanted finger millet. The soil was sandy clay loam in nature. The field experiment was laid out in split plot design and replicated thrice. The main plot consists of four different age of seedlings *viz*., 15, 18 and 21 days old seedlings raised from nutrient media (soil (70%) + well decomposed FYM (20%) + rice hull (10%) + DAP @ 7 g /tray + Azophos @14 g/tray + vermicompost @100 g/tray - with a tray size of 60 × 30 cm) and simultaneously 17 days old seedlings also raised from conventional method. In subplot, three levels of RDF *viz*., 75, 100 and 125% were used. The recommended dose of fertilizer was 60:30:30 kg NPK ha^{-1}. Observation like plant height and dry matter production were recorded at harvest stage and number of tillers hill^{-1} was recorded at 60 DAT. The yield attributes like number of productive tillers, earheads m^{-2}, number of filled grains earhead^{-1} and yield of grain and straw were recorded.

Results and Discussion

Growth parameters: The growth parameters *viz*., plant height, number of tillers hill^{-1} and dry matter production were diversely influenced by different age of seedlings and levels of fertilizer used. Transplanting of 15 days old seedlings from nutrient media registered higher plant height (103.4 cm), number of tillers hill^{-1} (8.4) and dry matter production (8834 kg ha^{-1}) and it was statistically on par with 18 days old seedlings raised from nutrient media recorded the plant height (98.3 cm), number of tillers (7.9) and dry matter production (8313 kg ha^{-1}) (Table 1). The higher growth parameters achieved from the above treatments might be due to the seedlings took lesser number of days for transplanting shock and greater number of primary and secondary roots in younger seedlings. These active roots helped in higher uptake of nutrients at an early stage of crop growth led to increased growth parameters. This result was similar with Ramachandra *et al.* (2012) [16]. Whereas 21 days old seedlings from nutrient media recorded lesser plant height (85.9 cm), number of tillers (5.9) and dry matter production (7277 kg ha^{-1}). Planting of 17 days old seedlings from conventional method performed equally with 18 days old seedlings raised from nutrient media on growth parameters of ragi.

Table 1: Effect of age of seedlings and different levels of fertilizer on growth characters of transplanted finger millet

Plant height (cm)					**No. of tiller hill^{-1}**					**Dry matter production (kg ha^{-1})**				
	S1	**S2**	**S3**	**Mean**		**S1**	**S2**	**S3**	**Mean**		**S1**	**S2**	**S3**	**Mean**
M1	86.7	94.7	97.3	92.9	M1	6.6	7.5	8.0	7.4	M1	7453	7863	8392	7903
M2	98.6	103.2	108.5	103.4	M2	7.8	8.4	8.9	8.4	M2	7853	9126	9524	8834
M3	93.9	98.7	102.3	98.3	M3	7.5	8.1	8.2	7.9	M3	7604	8437	8897	8313
M4	77.7	88.2	91.7	85.9	M4	5.2	5.9	6.7	5.9	M4	6641	7352	7838	7277
Mean	89.2	96.2	100.0		Mean	6.8	7.5	8.0		Mean	7388	8195	8663	
	M	**S**	**M at S**	**S at M**		**M**	**S**	**M at S**	**S at M**		**M**	**S**	**M at S**	**S at M**
S.Ed	3.1	3.1	3.0	2.6	S.Ed	0.3	0.3	0.2	0.2	S.Ed	259	255	267	227
CD (*p*=0.05)	6.6	6.5	6.4	5.4	CD (*p*=0.05)	0.7	0.6	0.5	0.4	CD (*p*=0.05)	550	540	566	481

With regard to different levels of fertilizer, application of 125% RDF was recorded higher plant height (100.0 cm), number of tillers (8.0) and dry matter production (8663 kg ha^{-1}). However, it was on par with 100% RDF produced the plant height of 96.2 cm, number of tillers hill^{-1} of 7.5 and dry matter production of 8195 kg ha^{-1}. This might be due to higher dosage of fertilizers that increased the uptake of nutrients eventually increased the growth contributing characters of finger millet (Manjunatha *et al.*, 2010) [11]. The minimum growth parameters were observed with 75% RDF.

On interaction, age of seedlings and levels of inorganic fertilizer were significantly influenced the growth parameters of finger millet. Transplanting of 15 days old seedlings from nutrient media along with application of 125% RDF showed maximum plant height (108.5 cm) number of tillers (8.9) and dry matter production (9524 kg ha^{-1}) and it was on par with 15 days old seedlings along with 100% RDF. This might be due to profuse rooting ability of young seedlings, maximum utilization of nutrients and other resources effectively at early stages resulted in higher growth characters. This similar results were confirmed with Kumar *et al.* (2019) [16]. Transplanting of 21 days old seedlings coupled with 75% RDF registered lesser plant height (77.7 cm), number of tillers hill^{-1} (5.2) and dry matter production (6641 kg ha^{-1}). Aged seedlings and heavy root damage occurred at the time of uprooting of seedlings resulted in more time for recovery and less availability of nutrients might be the reason for getting lesser growth characters (Singh *et al.*, 2018) [17].

Yield attributes

Yield attributes like number of productive tillers, earheads m^{-2} and filled grains earhead^{-1} were significantly influenced by different age of seedlings and levels of fertilizer used. With respect to age of seedlings, maximum number of productive tillers (6.5), earheads m^{-2} (140) and number of filled grains earheads^{-1} (1512) were obtained from transplanting of 15 days old seedlings raised under nutrient media and it was on par with 18 days old seedlings recorded 6.2 productive tillers hill^{-1}, earheads m^{-2} (127) and number of filled grains earhead^{-1} (1403) (Table 2). This might be due to lesser transplanting shock period and greater establishment of plants with more growth characters resulted in higher yield attributes. Similar findings were reported by Anitha (2015) [4] and Manjunatha *et al.* (2010) [11]. The minimum number of yield attributes were recorded with 21 days old seedlings. Transplanting of 17 days old seedlings from conventional method equally produced yield attributes as that of 18 days old seedlings raised from nutrient media.

Table 2: Effect of age of seedlings and different levels of fertilizer on yield attributes of transplanted finger millet

Productive tillers hill^{-1}					Earheads m^{-2}					Filled grains earhead^{-1}				
	S1	**S2**	**S3**	**Mean**		**S1**	**S2**	**S3**	**Mean**		**S1**	**S2**	**S3**	**Mean**
M1	5.3	5.8	6.2	5.8	M1	109	119	126	118	M1	1103	1378	1452	1311
M2	6.1	6.6	6.9	6.5	M2	123	145	153	140	M2	1236	1603	1696	1512
M3	5.8	6.3	6.4	6.2	M3	115	127	138	127	M3	1183	1468	1557	1403
M4	4.5	5.1	5.5	5.0	M4	90	105	116	104	M4	1017	1136	1223	1125
Mean	5.4	5.9	6.3		Mean	109	124	133		Mean	1135	1396	1482	
	M	**S**	**M at S**	**S at M**		**M**	**S**	**M at S**	**S at M**		**M**	**S**	**M at S**	**S at M**
S.Ed	0.2	0.2	0.2	0.2	S.Ed	6	6	4	3	S.Ed	52	50	47	40
CD (p=0.05)	0.5	0.4	0.4	0.3	CD (p=0.05)	13	12	9	7	CD (p=0.05)	110	106	99	84

Likewise, application of 125% RDF recorded higher number of productive tillers (6.3), earheads m^{-2} (133) and number of filled grains earhead^{-1}(1482) and it was on par with the recommended dose of fertilizer. This maximum yield attributes observed in the said treatments might be due to enlargement of cell, stem elongation, more number of functional leaves which occurred as an outcome of enhanced level of nutrients led to increased growth parameters resulted in higher photosynthetic activity and grater accumulation of photosynthates into sink. Similar findings were reported by Abhishek and Avudaithai (2018) [1]. The minimum number of productive tillers (5.4), earheads m^{-2} (109) and number of filled grains earhead^{-1} (1135) was obtained with application of 75% RDF.

Transplanting of 15 days old seedlings from nutrient media along with 125% RDF recorded maximum number of productive tillers (6.9), earheads m^{-2} (153) and number of filled grains earhead^{-1} (1696). It was on par with transplanting of 15 days old seedlings raised from nutrient media coupled with 100% RDF. This might be due to transplanting of younger age seedlings with application of higher dose of fertilizer supported with strong root system, higher number of tillers and increased plant metabolism led to increased yield contributing characters. These findings have also been confirmed by Nevse *et al.* (2013) [13]. Transplanting of 21 days old seedlings with application of 75% RDF was recorded lesser number of productive tillers (4.5), earheads m^{-2} (90) and number of filled grains earhead^{-1} (1017). Minimum yield attributing traits resulting from less uptake and translocation of nutrients in older seedlings (Fahad *et al.*, 2015) [6].

Grain and straw yield

Grain and straw yield were greatly influenced by different age of seedlings and levels of fertilizer. Maximum grain (3267 kg ha^{-1}) and straw yield (6001 kg ha^{-1}) were recorded with transplanting of 15 days old seedlings raised from nutrient media and it was on par with transplanting of 18 days old seedlings from nutrient media registered grain and straw yield of 3061 and 5676 kg ha^{-1}, respectively (Table 3). This might be due to planting of younger seedlings produced maximum growth and yield parameters which was resulted in higher grain and straw yield of finger millet (Adhikari *et al.*, 2013 [2], Chaudhari *et al.*, 2015) [5]. The minimum grain (2709 kg ha^{-1}) and straw yield (5129 kg ha^{-1}) were obtained by transplanting of 21 days old seedlings. Whereas, transplanting of 17 days old seedlings raised from conventional method similarly reacted on the yield of finger millet as that of 18 days old seedlings raised from nutrient media.

Table 3: Effect of age of seedlings and different levels of fertilizer on grain and straw yield of transplanted finger millet

Grain yield (kg ha^{-1})					Straw yield (kg ha^{-1})				
	S1	**S2**	**S3**	**Mean**		**S1**	**S2**	**S3**	**Mean**
M1	2654	3048	3176	2959	M1	5123	5549	5789	5487
M2	2803	3397	3602	3267	M2	5329	6191	6484	6001
M3	2708	3162	3314	3061	M3	5225	5746	6058	5676
M4	2485	2723	2918	2709	M4	4752	5207	5427	5129
Mean	2663	3083	3253		Mean	5107	5673	5940	
	M	**S**	**M at S**	**S at M**		**M**	**S**	**M at S**	**S at M**
S.Ed	104	101	100	85	S.Ed	160	157	186	158
CD (p=0.05)	220	215	213	181	CD (p=0.05)	340	333	393	334

Application of 125% RDF recorded higher grain (3253 kg ha^{-1}) and straw yield (5940 kg ha^{-1}). However, it was on par with the application of 100% RDF. This might be due to better growth parameters resulting from maximum uptake of nutrients which was reflected in higher yield attributing characters and finally resulted in higher grain and straw yield (Hussain *et al.*, 2012, Narayan and Ramachandrappa, 2017) [6, 8, 12]. The lesser grain (2663 kg ha^{-1}) and straw yield (5107 kg ha^{-1}) were recorded with application of 75% RDF.

On interaction effect, maximum grain (3602 kg ha^{-1}) and straw yield (6484 kg ha^{-1}) were registered when transplanting of 15 days old seedlings raised from nutrient media along with 125% of recommended dose of fertilizer. However, it was on par with transplanting of 15 days old seedlings combined with 100% RDF. This might be due to younger seedlings that develop their roots rapidly because of lesser transplanting shock and minimal root damage during transplanting resulted in the absorption of higher nutrients from the soil than the older seedlings. It promoted the growth characters and yield attributes which resulted in higher grain and straw yield of finger millet. The lesser grain (2485 kg ha^{-1}) and straw yield (4752 kg ha^{-1}) were obtained with 21 days old seedlings along with application of lesser recommended dose of fertilizer (75%). Similar findings were reported by Pramanik and Bera (2013) [15] and Nevse *et al.* (2013) [13].

Conclusion

From the investigation it could be concluded that, planting 15 days old seedlings raised from nutrient media along with application of 125% RDF recorded higher growth, yield attributes, grain and straw yield of transplanted finger millet and it was on par with transplanting of 15 days old seedlings

raised from nutrient media with 100% RDF. Thus, the study recommended that transplanting of 15 days old seedlings raised from nutrient media with 100% RDF was the best management practices to get higher yield in transplanted finger millet.

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