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Influence of Seedling Age and Plant Geometry on Yield and Uptake of Nutrients in Transplanted Peralmillet Under Late Sown Condition

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Abstract

An field experiments were conducted during the Kharif seasons of 2015 and 2016 at R. V. S. K. V. V., Gwalior with 3 age of seedling (15, 20 and 25 days) and 8 plant geometry (30x10, 30x20, 30x30, 30x40, 45x10, 45x20, 45 x30 and 45x40 cm) in split-plot design in 3 replications. Pooled data of two years revealed that the crop transplanted with 20 days old seedling produced maximum grain yield (2176 kg ha^{-1}) followed by 25 days old (2122.6 kg ha^{-1}) and 15 days old seedling which gave lowest grain yield (1965.1 kg ha^{-1}). Under different plant geometry, maximum grain yield (2243.3 kg ha^{-1}) was obtained with 45 x 20 plant geometry which was closely followed by 30 cm x 40 cm plant geometry with grain yield 2238.3 kg ha^{-1}.The research further suggests that uptake values of nutrients were accordance with yield and their contents and maximum total NPK uptake values were observed with 20 days old seedling planted at 45 cm x 20 cm plant geometry.

***Key words**: Nutrient uptake, plant geometry, seedling age, transplanted pearlmillet, yield*

Introduction

Pearlmillet is an important food crop grown in both rainy *(kharif) and summer*seasons in Madhya Pradesh. Transplanting increases the yield and also compensates the yield in case of delayed sowing. Similarly, age of seedlings plays vital role in establishment and tolerance to withstand root injury shocks during the process of transplanting. Age of seedlings is an important consideration in transplanting. Onset of the rainy season in semi-arid tropics is highly variable. If nurseries are established early and the rains come late, plants may be too old to be transplanted. Old transplants have high transpiration rates due to greater leaf area and this may affect establishment. Transplanting of seedling increase the yield and also compensate the yield losses due to delay sowing[5]. The plant density can be adjusted by the application of different spacing. Plant geometry influences yield and yield contributing characters of wheat. Higher plant density generally increase plant population resulting inter crop competition there by affecting the yield. On the other hand, lower plant density may reduce the yield drastically. With a view to examine critically the referred situation to achieve maximum yield in late sown condition, the present experiment was planned.

Materials and Methods

The field experiment was conducted during the *Kharif*seasons of 2015 and 2016 at Gwalior, on sandy clay loam soil having 0.42% organic carbon, 187 kg ha^{-1} available-N, 16.5 kg available P_2O_5 and 236.2 kg K_2O ha^{-1}, with pH 7.8. Treatment combinations of 3age of seedling (15, 20 and 25 days) in main plot and 8 plant geometry (30x10, 30x20, 30x30, 30x40, 45x10, 45x20, 45 x30 and 45x40 cm) in subplot were tested in split-plot design with 3 replications. Sowing dates for different seedling age given in table 1. Pearlmillet variety 'JBV 3' was transplanted on 27 and 23 July at 2015 and 2016, respectively. All the plots were uniformly fertilized with 80 kg N, 40 kg P_2O_5 and 20 kg K_2O ha^{-1}. The crop was receiving 280.4 and 443.4mm rainfall and

harvested on 19 and 13 October in first and second years, respectively.

Results and Discussion

Seedling age

Growth, yield attributes and yield of transplanted pearl millet were significantly influenced due to different seedling age (Table 2).Growth parameters like plant height and yield attributes like number of effective tillers per square meter, length of earhead, number of grains per earhead and test weight were significantly influenced by different seedling age and maximum values were recorded with 20 days old seedling. Transplanting with younger seedling (15 days old) produced significantly the lowest plant height as well as yield attributes characters at harvest than 20 and 25 days old seedling. This might be due to poor root development and survival with early transplanted seedlings (15 days old) in pearlmillet. Poor development of seminal roots in this stage resulted lesser number of tillers in the plants[3,4]. The increase in yield attributes with 20 days old seedling over 25 days and 15 days old seedlings was owing to quick establishment of seedling, as it has ability to absorb root injury shocks[5].

Table 1 Schedule of raising of seedling

Year	Date of transplanting	Dates for nursery sowing		
		For 25 days	For 20 days	For 15 days
2015	27 July	2 July	7 July	12 July
2016	23 July	28 June	3 July	8 July

The results with regard to grain and stover yields (Table 2) were significantly influenced by seedling age. Among various seedling ages, transplanting with 20 days old seedling (A_2) recorded significantly higher grain and stover yield but it was at par with 25 days old seedling (A_3) and both were significantly superior to 15 days old seedling (A_1). Transplanting of healthy and optimum aged seedlings ensures cell turgidity and consequently higher meristematic activity leading to more foliage development, greater photosynthetic rate, higher nutrient uptake and better growth of plants[5].

Plant geometry (Spacing's: Row to Row x Plant to Plant)

Plant geometry had significant effects on yield attributes (sink components) of transplanted pearlmillet. Maximum values of yield attributing characters were produced at plant geometry of 45 cm x 20 cm, followed by 45 cm x 30, 45 cm x 40 cm and 30 x 40 cm. Minimum values of yield attributing characters recorded in 30 cm x 10 cm spacing treatment, which was significantly inferior over rest of the spacing treatment. These might be attribute to proper utilization of available resources i.e. moisture and nutrient which might have remained under utilized due to mutual plant competition developed by more plant in closer spacing. The spacing of 60 cm x 20 cm significantly increased the cob length, cob girth, cob weight, grains weight/cob, of hybrid maize than the spacing of 60cm x 25 cm and 45cm x 20 cm[6].

The data pertaining to number of earheadper square meter areaat maturity revealed the maximum earhead (38.79 m^{-2}) noted with closer (30 x 10 cm) spacing which was significantly higher over rest of the treatment. The higher tillers per meter square at the narrow row spacing was likely due to more uniform spatial distribution and less in row plant to plant competition compared with the wider row spacing.

Increase in plant geometry from S_1 (30 cm x 10 cm) increased the grain yield progressively and significantly higher over S_1. On pooled basis, maximum grain yield (2243.3 kg ha^{-1}) was obtained with 45 x 20 cm (S_6) plant geometry which was closely followed by 30 x 40 cm plant geometry with 2238.3 kg ha^{-1} grain yield. The significant increase in grain yield in S_6 was 26.3, 13.7, 11.0 and 6.5 % over to S_1, S_2, S_5 and S_3, respectively. This is because under very close

row spacing competition for light and other resources were more resulting in low yield[1].

Nutrient uptake

The different seedling ages showed significant influence on the nutrient uptake by pearl millet (Table 2). The maximum value of N, P & K uptake was noticed with 20 days old seedling (A_2) and minimum under 15 days old seedling (A_1). The lower uptake of nutrients in younger seedling (15 days old) is due to lower yields obtained in these plots. Transplanting of pearlmillet with 20 or 25 old seedling was comparable in terms of N P K uptake by grain and stover and significantly higher than N, P and K uptake by younger seedling (15 days old). Plant geometry of 45 cm x 20cm had significantly higher total uptake of N, P and K which might ascribed to it relatively higher grain and stover yield than wider (45 x 30 and 45 x 40 cm) and narrow (30 x 20 and 30 x 10 cm) spacing. Further, more biomass was produced at the wider spacing than narrow spacing indicating better resource utilization in wider row spacing than narrow rows.

Table 2 Effect of seedling age and plant geometry on growth, yield attributes and yield of transplanted peralmillet (Pooled data of two years)

Treatment	Plant height (cm)	Number of effective tillers m^{-2}	Length of earhead (cm)	Number of grains $earhead^{-1}$	1000- grain weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest Index (%)
Seedling age								
A_1: 15 days	172.18	29.03	20.47	3707.1	9.23	1965.1	5677.2	25.71
A_2: 20 days	187.97	30.85	22.41	4019.3	10.27	2176.5	6123.8	26.22
A_3: 25 days	181.06	27.13	22.27	3997.4	10.20	2122.6	6076.6	25.89
SE (m) ±	**0.89**	**0.27**	**0.09**	**8.6**	**0.05**	**18.9**	**63.6**	**0.09**
C.D. (5%)	**2.90**	**0.89**	**0.30**	**28.2**	**0.15**	**61.7**	**207.5**	**0.29**
Plant geometry (Spacing's: Row to Row x Plant to Plant)								
S_1: 30 cm x 10 cm	173.51	38.79	20.08	3621.4	9.12	1776.2	5296.5	25.11
S_2: 30 cm x 20 cm	176.52	31.37	21.46	3842.0	9.75	1973.8	5649.1	25.89
S_3: 30 cm x 30 cm	178.00	23.15	21.59	3854.3	9.80	2107.4	5961.6	26.12
S_4: 30 cm x 40 cm	177.79	23.81	21.36	3892.5	9.94	2238.3	6356.9	26.04
S_5: 45 cm x 10 cm	179.38	34.57	21.35	3849.3	9.59	2021.9	5835.8	25.73
S_6: 45 cm x 20 cm	189.33	29.16	22.74	4087.9	10.37	2243.6	6386.2	26.00
S_7: 45 cm x 30 cm	183.88	25.10	22.59	4056.3	10.28	2174.2	6119.4	26.22
S_8: 45 cm x 40 cm	184.79	26.09	22.57	4059.6	10.36	2169.2	6068.3	26.33
SE (m) ±	**1.85**	**0.48**	**0.21**	**36.3**	**0.11**	**28.2**	**81.0**	**0.14**
C.D. (5%)	**5.23**	**1.36**	**0.60**	**102.7**	**0.30**	**79.8**	**229.2**	**0.39**

Table 3 Effect of seedling age and plant geometry on nutrient uptake by transplanted peralmillet (Pooled data of two years)

Treatment	N-Uptake (kg ha^{-1})			P-Uptake (kg ha^{-1})			K-Uptake (kg ha^{-1})		
	Grain	Stover	Total	Grain	Stover	Total	Grain	Stover	Total
Seedling age									
A_1: 15 days	31.13	38.08	69.22	7.87	7.68	15.55	14.24	73.91	88.15
A_2: 20 days	36.22	40.74	76.95	8.84	8.27	17.11	15.93	80.59	96.52
A_3: 25 days	36.02	38.23	74.25	8.19	7.79	15.98	14.82	76.40	91.23
SE (m) ±	**0.33**	**0.20**	**0.41**	**0.06**	**0.08**	**0.09**	**0.13**	**0.71**	**0.82**
C.D. (5%)	**1.08**	**0.64**	**1.35**	**0.20**	**0.27**	**0.30**	**0.42**	**2.32**	**2.67**
Plant geometry (Spacing's: Row to Row x Plant to Plant)									
S_1: 30 cm x 10 cm	26.90	31.91	58.81	6.56	6.51	13.08	12.07	65.16	77.23
S_2: 30 cm x 20 cm	31.90	36.40	68.30	7.72	7.44	15.16	14.09	72.77	86.86
S_3: 30 cm x 30 cm	34.63	38.74	73.36	8.36	7.98	16.34	15.05	76.34	91.38
S_4: 30 cm x 40 cm	36.76	41.63	78.39	8.87	8.35	17.23	16.04	81.56	97.90
S_5: 45 cm x 10 cm	33.75	38.65	72.40	8.13	7.85	15.98	14.65	76.08	90.73
S_6: 45 cm x 20 cm	38.19	42.94	81.13	9.11	8.73	17.84	16.39	83.76	100.15
S_7: 45 cm x 30 cm	37.10	41.30	78.40	8.83	8.27	17.12	15.92	80.38	96.80
S_8: 45 cm x 40 cm	36.43	40.58	77.01	8.80	8.19	16.98	15.80	79.69	95.49
SE (m) ±	**0.60**	**0.67**	**1.04**	**0.13**	**0.13**	**0.26**	**0.22**	**1.09**	**1.24**
C.D. (5%)	**1.69**	**1.89**	**2.95**	**0.36**	**0.37**	**0.74**	**0.63**	**3.07**	**3.50**

Conclusion

Therefore from present study, we concluded that 20 days old seedling of pearlmillet transplanted with 45 cm x 20 cm plant geometry may be beneficial under late sown condition in Gwalior district.

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