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# Popularizing Millet Cultivation: Optimising Crop Spacing and Identifying A Suitable Variety of Pearl Millet (*Pennisetum glaucum*) for Southern Laterites of Kerala

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***Abstract*:** Millets are gaining popularity in the changing scenario of global climate, based on their ability to withstand harsh weather conditions, adaptability in marginal lands and also because of their nutritional significance. Standardisation of the agro techniques of pearl millet could lead to popularisation of the crop and experiment was conducted at College of Agriculture, Vellayani, KAU in identifying a suitable variety and optimum spacing for pearl millet grown in Southern laterites of Kerala. Five pearl millet varieties *viz*., ICMV 221, VPMV 9, MH 946, ICTP 8203 and CO 10 were experimented under two spacings i.e., 30 cm X 20 cm and 45 cm X 15 cm during Rabi, 2022 and Summer, 2023. Among varieties, CO 10 performed significantly better in terms of growth attributes, uptake of major nutrients and yield performance followed by ICMV 221.The crop spacing, 30 cm X 20 cm exhibited significantly higher growth, nutrient uptake, and yield in comparison to 45 cm X 15 cm. The interaction effect of varieties and spacing was also significant with CO 10 performing significantly better growth, nutrient uptake and yield under 30 cm x 20 cm spacing. The study recommends cultivation of CO 10 in the southern laterites of Kerala under a crop spacing of 30 cm x 20 cm, optimum for growth and yield.

***Keywords*:** Pearl millet, Varieties, Spacing, Growth, Nutrient uptake, Yield

Global climate change and extreme weather fluctuations have emerged the most threatening challenges to agriculture particularly in the production of important cereals crops. In this scenario, millets have emerged climate smart crops for next generation agriculture. Millets have the ability to withstand high temperatures, drought and poor soil conditions which makes them invaluable assets in sustainable agriculture. Millets are rich sources of dietary fibres, vitamins, and minerals (Chaurasia and Anichari 2023). Due to their exceptional nutritional profile and potential health benefits, millets are also regarded as “nutraceuticals” as well as 'famine reserves' considering their prolonged shelf life.

Pearl millet (*Pennisetum glaucum* L.) is an important millet crop having multipurpose utility as food feed and forage. The low glycaemic index and gluten free nature of the grain makes it a preferred crop for those having gluten allergies and diabetes. In India, pearl millet production was approximately 17.32 million tonnes during 2022-2023 with a productivity of 1401 kg per hectare (India data insights 2023). Pearl millet is being popularized as a market-oriented crop owing to the varied uses such as animal feed, potable alcohol, processed food etc (Yadav and Rai 2013).

Optimum spacing allows plants to receive adequate sunlight, nutrients and water, which are essential for better growth and establishment. It also helps to prevent overcrowding, thereby eliminating any competition for soil water and nutrients. The soil and climatic conditions of Kerala are congenial for growing a variety of millets as experienced from success stories of several farmers. However, as the agrotechniques for most of the millets are not standardised for Kerala conditions, this experiment aimed in promoting cultivation of a major millet crop *i.*e., Pearl millet in the southern laterites (Agro Ecological Unit - 8) of Kerala by way of identifying a suitable variety for the region and also optimising the crop spacing for better crop yield.

## MATERIAL AND METHODS

The study was conducted during *Rabi*, 2022 (September 2022 - January 2023) and summer, 2023 (March to July 2023) at College of Agriculture, Vellayani. The experimental field was located at 8°25'39" N latitude and 76°59' 9" E longitude, at an altitude of 19 m above msl. The soil was sandy loam belonging to the order Oxisol with acidic pH (5.6), safe electrical conductivity (0.2 ds $m^{-1}$) and medium organic carbon content (1.23 %). The soil was low in available nitrogen (247.31 kg $ha^{-1}$), high in available phosphorus (247.31 kg $ha^{-1}$) and medium in available potassium (226.5 kg $ha^{-1}$).

Pearl millet varieties ICMV 221, VPMV 9, MH 946, ICTP 8203 and CO 10 were cultivated under two different crop

spacings of 30 cm X 20 cm and 45 cm X 15 cm. The crop was maintained as per the package of practices recommendations of Kerala Agricultural University (KAU 2016). Seeds at the rate of 4 kg $ha^{-1}$ were dibbled. Farmyard manure was applied at the rate of 5 t $ha^{-1}$ at the time of land preparation. N, P and K fertilizers were applied at the rate of 70:35:35 kg $ha^{-1}$ for crop nourishment. Entire dose of phosphorus and potash was applied as basal. Nitrogen was applied at two equal splits, half as basal and the rest at 30 DAS.

Biometric observations were periodically recorded and the grain and straw yield from respective treatment plots were recorded at harvest. Nitrogen content of plants was analysed using the modified microkjeldahl method (Jackson 1973). Phosphorus content was analysed using Vanadomolybdate phosphoric yellow colour method (Piper 1966). Potassium content was analyzed using flame photometer method. The plant nutrient contents were then multiplied with total dry matter production to obtain the uptake of respective nutrients and expressed in kg $ha^{-1}$ (Piper 1966). The data generated from the experiment were statistically analyzed using analysis of variance technique (Gopinath et al., 2021).

## RESULTS AND DISCUSSION

**Growth parameters:** At all the stages i.e., 40, 60 DAS and at harvest, significant enhancement in plant height was observed with variety CO 10 followed by ICMV 221 (Table 1). Similar trend was observed for DMP which was significantly higher in CO 10 followed by ICMV 221. Probably, the superior genetic traits of CO 10 varieties contributed to enhanced growth (Sumathi et al., 2017). The uptake of major

**Table 1.** Varietal differences and crop spacing in influencing the growth attributes of pearl millet

| Treatments | Plant height (cm) | | | | | | DMP (g) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Rabi* 2022 | | | Summer 2023 | | | *Rabi* 2022 | | | Summer 2023 | | |
| | 40 DAS | 60 DAS | Harvest | 40 DAS | 60 DAS | Harvest | 40 DAS | 60 DAS | Harvest | 40 DAS | 60 DAS | Harvest |
| Variety (v) | | | | | | | | | | | | |
| $v_1$: ICMV221 | 100.08 | 166.00 | 186.25 | 87.58 | 160.08 | 182.00 | 32.22 | 57.47 | 94.95 | 29.62 | 54. 11 | 91.20 |
| $v_2$: VPMV9 | 95.25 | 164.00 | 181.58 | 82.75 | 156.60 | 177.42 | 29.62 | 53.61 | 93.30 | 27.40 | 51.91 | 89.63 |
| $v_3$: MH946 | 87.60 | 162.08 | 174.83 | 74.10 | 153.73 | 170.58 | 28.40 | 50.47 | 90.09 | 26.33 | 47.00 | 86.70 |
| $v_4$: ICTP8203 | 94.08 | 164.75 | 185.42 | 81.58 | 159.08 | 182.08 | 30.71 | 54.97 | 94.65 | 28.84 | 53.23 | 90.98 |
| $v_5$: Co-10 | 104.21 | 172.33 | 189.42 | 93.46 | 168.08 | 185.92 | 33.48 | 59.05 | 96.95 | 30.66 | 56.05 | 92.64 |
| CD (p=0.05) | 4.631 | 3.324 | 3.141 | 4.631 | 3.794 | 3.179 | 1.038 | 1.079 | 0.995 | 0.989 | 1.61 | 1.745 |
| Spacing (s) | | | | | | | | | | | | |
| $s_1$: 30X 20cm | 101.67 | 167.93 | 188.23 | 91.27 | 162.53 | 185.33 | 32.175 | 56.80 | 96.22 | 53.42 | 92.47 | 53.42 |
| $s_2$: 45X 15cm | 90.82 | 163.73 | 178.77 | 76.52 | 156.50 | 173.87 | 29.598 | 53.44 | 91.76 | 51.50 | 87.98 | 51.50 |
| CD (p=0.05) | 2.929 | 2.102 | 1.987 | 2.929 | 2.399 | 2.011 | 0.656 | 0.682 | 0.629 | 1.018 | 1.104 | 1.018 |
| Interaction (v X s) | Plant height (cm) | | | | | | DMP (g) | | | | | |
| | *Rabi* 2022 | | | Summer 2023 | | | *Rabi* 2022 | | | Summer 2023 | | |
| | 40 DAS | 60 DAS | Harvest | 40 DAS | 60 DAS | Harvest | 40 DAS | 60 DAS | Harvest | 40 DAS | 60 DAS | Harvest |
| $v_1s_1$ | 104.17 | 167.00 | 190.33 | 94.17 | 162.17 | 186.83 | 33.76 | 58.81 | 96.60 | 29.86 | 55.14 | 93.45 |
| $v_1s_2$ | 96.00 | 165.00 | 182.17 | 81.00 | 158.00 | 177.17 | 30.68 | 56.14 | 93.30 | 29.38 | 53.07 | 88.96 |
| $v_2s_1$ | 97.33 | 163.67 | 186.17 | 87.33 | 156.50 | 182.67 | 30.17 | 54.75 | 95.67 | 27.02 | 51.13 | 91.68 |
| $v_2s_2$ | 93.17 | 164.33 | 177.00 | 78.17 | 156.70 | 172.17 | 29.08 | 52.47 | 90.94 | 27.78 | 52.70 | 87.59 |
| $v_3s_1$ | 96.33 | 166.50 | 183.67 | 84.33 | 159.67 | 180.17 | 29.89 | 53.08 | 93.30 | 27.96 | 49.93 | 90.73 |
| $v_3s_2$ | 78.87 | 157.67 | 166.00 | 63.87 | 147.80 | 161.00 | 26.91 | 47.88 | 86.89 | 24.69 | 44.07 | 82.66 |
| $v_4s_1$ | 98.17 | 166.50 | 187.83 | 88.17 | 162.50 | 185.83 | 31.15 | 56.24 | 96.46 | 28.64 | 53.26 | 92.22 |
| $v_4s_2$ | 90.00 | 163.00 | 183.00 | 75.00 | 155.67 | 178.33 | 30.27 | 53.70 | 92.83 | 29.05 | 53.21 | 89.73 |
| $v_5s_1$ | 112.33 | 176.00 | 193.17 | 102.33 | 171.83 | 191.17 | 35.90 | 61.11 | 99.07 | 31.48 | 57.64 | 94.30 |
| $v_5s_2$ | 96.08 | 168.67 | 185.67 | 84.58 | 164.33 | 180.67 | 31.06 | 57.00 | 94.83 | 29.84 | 54.46 | 90.98 |
| CD (p=0.05) | 6.550 | 4.700 | 4.442 | NS | 5.365 | 4.496 | 1.468 | 1.526 | 1.407 | 1.398 | 2.276 | 2.468 |

nutrients N, P and K at harvest stage was significantly higher with varieties $V_5$ and $V_1$ (Table 3) which could be related with the enhanced growth attributes for these varieties at harvest.

Under the spacing $S_1$ (30 cm X 20 cm), significantly taller plants and enhanced DMP were observed compared to $S_2$ at all the growth stages under study. Among V x S interactions, $V_5S_1$ (CO 10 under 30 cm X 20 cm) recorded significant enhancement with respect to plant height and DMP at all the growth stages under study. Plants grown close can shade each other which can reduce the amount of sunlight they receive. Mutual competition for sunlight can therefore be severe under closer plant to plant spacing (Singh et al., 2012). Under $S_1$, plant to plant spacing of 20 cm was maintained whereas in $S_2$, was 15 cm. As plant to plant spacing increases, due to less number of plants within the row, there is increased availability of resources including sunlight, moisture and nutrients for individual plants, which promotes more vigorous growth and development (Legese 2024).

Dry weight is a net result of plant height, number of tillers and leaf area. Spacing $S_1$ (30 cm X 20 cm) had significantly more number of tillers (Table 4) which could be related with the increased DMP under $S_1$. The plant population under $S_1$ was 1.66,667 plants per hectare whereas under $S_2$, it was 1,48,148 plants. Higher plant population results in increased leaf area index due to more green canopy cover per unit area. This in turn results in enhanced photosynthesis and hence more accumulation of photosynthates contributing to higher

**Table 2.** Varietal differences and crop spacing in influencing the nutrient uptake of pearl millet

| Treatments | NPK uptake (kg ha$^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | *Rabi* 2022 | | | Summer 2023 | | |
| | N uptake (kg ha$^{-1}$) | P uptake (kg ha$^{-1}$) | K uptake (kg ha$^{-1}$) | N uptake (kg ha$^{-1}$) | P uptake (kg ha$^{-1}$) | K uptake (kg ha$^{-1}$) |
| Variety (v) | | | | | | |
| $v_1$: ICMV221 | 91.28 | 19.25 | 93.29 | 83.87 | 13.24 | 80.56 |
| $v_2$: VPMV9 | 80.28 | 17.77 | 89.64 | 78.39 | 11.94 | 74.23 |
| $v_3$: MH946 | 74.58 | 13.76 | 84.45 | 73.23 | 9.35 | 69.09 |
| $v_4$: ICTP8203 | 84.86 | 18.74 | 91.39 | 81.24 | 12.35 | 76.71 |
| $v_5$: Co-10 | 95.09 | 21.97 | 96.59 | 86.64 | 14.54 | 83.86 |
| CD (p=0.05) | 3.405 | 1.155 | 2.985 | 3.984 | 1.266 | 3.302 |
| Spacing (s) | | | | | | |
| $s_1$: 30X 20cm | 90.62 | 20.57 | 92.51 | 85.09 | 13.89 | 78.51 |
| $s_2$: 45X 15cm | 79.82 | 16.03 | 89.64 | 76.25 | 10.67 | 75.27 |
| CD (p=0.05) | 2.153 | 0.73 | 1.888 | 2.520 | 0.801 | 2.089 |
| Interaction (v X s) | NPK uptake (kg ha$^{-1}$) | | | | | |
| | *Rabi* 2022 | | | Summer 2023 | | |
| | N uptake (kg ha$^{-1}$) | P uptake (kg ha$^{-1}$) | K uptake (kg ha$^{-1}$) | N uptake (kg ha$^{-1}$) | P uptake (kg ha$^{-1}$) | K uptake (kg ha$^{-1}$) |
| $v_1s_1$ | 94.65 | 20.82 | 93.76 | 90.19 | 15.06 | 83.09 |
| $v_1s_2$ | 87.90 | 17.68 | 92.82 | 77.54 | 11.42 | 78.04 |
| $v_2s_1$ | 86.36 | 19.44 | 89.36 | 79.46 | 12.59 | 73.12 |
| $v_2s_2$ | 74.20 | 16.09 | 89.92 | 77.32 | 11.28 | 75.33 |
| $v_3s_1$ | 83.09 | 17.16 | 88.79 | 76.43 | 10.78 | 71.73 |
| $v_3s_2$ | 66.08 | 10.36 | 80.12 | 70.03 | 7.913 | 66.46 |
| $v_4s_1$ | 89.78 | 20.71 | 92.05 | 85.05 | 13.35 | 77.16 |
| $v_4s_2$ | 79.94 | 16.77 | 90.73 | 77.42 | 11.35 | 76.27 |
| $v_5s_1$ | 99.22 | 24.69 | 98.59 | 94.34 | 17.67 | 87.46 |
| $v_5s_2$ | 90.96 | 19.26 | 94.59 | 78.94 | 11.40 | 80.27 |
| CD (p=0.05) | 4.815 | 1.633 | 4.221 | 5.635 | 1.790 | 4.670 |

DMP (Sali 2022). Availability of sunlight is yet another major factor for better photosynthesis. Under wider plant to plant spacing, individual plants receive more sunlight resulting in better photosynthesis contributing to more dry matter accumulation (Qodliyati et al., 2018). Virat and Singh (2021) also identified that narrow row spacing resulted in increased dry matter accumulation in pearl millet attributed to efficient photosynthesis. Rana et al. (2013) observed that varieties influenced the total dry matter accumulation. Growth enhancement was with CO 10 variety and spacing of 30 cm X 20 cm reflected in significantly enhanced performance under interactions ($V_5S_1$) as well. Under a wider intra row spacing of 20 cm, probably proper utilization of space and sunlight occurred and there was a reduction in competition between plants for these resources which lead to improved growth.

**Nutrient uptake:** Results on the effect of different varieties, spacing and their interaction on nutrient uptake of pearl millet are presented in. Significant enhancement in N, P and K uptake was observed with variety CO 10 followed by ICMV 221 (Table 3). $S_1$ (30 cm X 20 cm) recorded significantly higher uptake of N, P and K. Among the interactions, $V_5S_1$ resulted in significantly highest N,P and K uptake (N-99.22 kg $ha^{-1}$, P-24.69 kg $ha^{-1}$, K-98.59 kg $ha^{-1}$ during *Rabi* and N-94.34 kg $ha^{-1}$, P-17.67 kg $ha^{-1}$, K-87.46 kg $ha^{-1}$ during summer). DMP was significantly higher with CO 10, closely followed by ICMV 221 (Table 1). As nutrient uptake is greatly influenced by dry matter accumulation, significantly higher uptake of nutrients under $V_5$ and $S_1$ could be well explained on the basis of higher DMP. Under $S_1$ (30 cm x 20 cm), the DMP was significantly higher compared to S the plant to plant spacing being more in $S_1$,

**Table 3.** Varietal differences and crop spacing in influencing the yield and ear head weight of pearl millet

| Treatments | NPK uptake (kg $ha^{-1}$) | | | | | |
|---|---|---|---|---|---|---|
| | *Rabi* 2022 | | | Summer 2023 | | |
| | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) | Ear head weight (g) | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) | Ear head weight (g) |
| Variety (V) | | | | | | |
| $v_1$: ICMV221 | 2323.96 | 6216.63 | 33.62 | 2148.51 | 6051.33 | 32.22 |
| $v_2$: VPMV9 | 2208.33 | 5805.12 | 31.40 | 1775.99 | 5756.01 | 29.62 |
| $v_3$: MH946 | 1992.29 | 5691.47 | 30.33 | 1614.51 | 5196.38 | 28.40 |
| $v_4$: ICTP8203 | 2264.58 | 6040.13 | 32.84 | 1878.77 | 5910.90 | 30.71 |
| $v_5$: Co-10 | 2469.37 | 6664.35 | 34.66 | 2385.10 | 6507.98 | 33.48 |
| CD(p=0.05) | 67.68 | 206.261 | 0.989 | 240.662 | 258.456 | 1.038 |
| Spacing (s) | | | | | | |
| $s_1$: 30X 20cm | 2314.19 | 6342.82 | 32.99 | 2164.77 | 6161.38 | 32.175 |
| $s_2$: 45X 15cm | 2189.23 | 5824.26 | 32.15 | 1756.38 | 5607.69 | 29.598 |
| CD (p=0.05) | 42.805 | 130.451 | 0.625 | 152.208 | 163.462 | 0.656 |
| Interaction (v X s) | NPK uptake (kg $ha^{-1}$) | | | | | |
| | *Rabi* 2022 | | | Summer 2023 | | |
| | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) | Ear head weight (g) | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) | Ear head weight (g) |
| $v_1s_1$ | 2318.75 | 6347.92 | 33.86 | 2148.48 | 6168.96 | 33.76 |
| $v_1s_2$ | 2329.17 | 6085.35 | 33.38 | 2148.55 | 5933.70 | 30.68 |
| $v_2s_1$ | 2247.91 | 6104.17 | 31.02 | 2072.22 | 5953.70 | 30.17 |
| $v_2s_2$ | 2168.75 | 5506.08 | 31.78 | 1479.76 | 5558.49 | 29.08 |
| $v_3s_1$ | 2157.28 | 6012.50 | 31.96 | 2012.64 | 5742.30 | 29.89 |
| $v_3s_2$ | 1827.30 | 5370.45 | 28.69 | 1216.39 | 4650.46 | 26.91 |
| $v_4s_1$ | 2281.25 | 6179.17 | 32.64 | 2095.40 | 6016.68 | 31.15 |
| $v_4s_2$ | 2247.92 | 5901.10 | 33.05 | 1662.14 | 5805.11 | 30.27 |
| $v_5s_1$ | 2565.73 | 7070.37 | 35.48 | 2495.11 | 6925.26 | 35.90 |
| $v_5s_2$ | 2373.00 | 6258.33 | 33.84 | 2275.09 | 6090.70 | 31.06 |
| CD (p=0.05) | 95.714 | 291.697 | 1.398 | 340.348 | 365.512 | 1.468 |

**Table 4.** Varietal differences and crop spacing ontiller numbers and productive tillers at harvest stage

| Treatments | Number of tillers | | Number of productive tillers | |
|---|---|---|---|---|
| | *Rabi* 2022 | Summer 2023 | *Rabi* 2022 | Summer 2023 |
| Variety (v) | | | | |
| $v_1$: ICMV221 | 40.17 | 36.33 | 25.30 | 22.78 |
| $v_2$: VPMV9 | 30.17 | 31.67 | 20.98 | 21.27 |
| $v_3$: MH946 | 26.83 | 29.00 | 17.48 | 19.09 |
| $v_4$: ICTP8203 | 38.60 | 32.67 | 23.55 | 22.55 |
| $v_5$: Co-10 | 42.67 | 40.00 | 28.80 | 25.00 |
| CD (p=0.05) | 3.652 | 1.863 | 4.693 | 1.684 |
| Spacing (s) | | | | |
| $s_1$: 30X 20cm | 36.87 | 36.67 | 24.06 | 22.32 |
| $s_2$: 45X 15cm | 34.53 | 31.20 | 22.38 | 21.96 |
| CD (p=0.05) | 2.309 | 1.178 | NS | NS |
| Interaction (v X s) | Number of tillers | | Number of productive tillers | |
| | *Rabi* 2022 | Summer 2023 | *Rabi* 2022 | Summer 2023 |
| $v_1s_1$ | 41.33 | 38.67 | 25.92 | 22.44 |
| $v_1s_2$ | 39.00 | 34.00 | 24.68 | 23.11 |
| $v_2s_1$ | 31.00 | 35.00 | 22.21 | 21.96 |
| $v_2s_2$ | 29.33 | 28.33 | 19.75 | 20.59 |
| $v_3s_1$ | 29.00 | 33.00 | 18.51 | 19.29 |
| $v_3s_2$ | 24.67 | 25.00 | 16.46 | 18.89 |
| $v_4s_1$ | 41.00 | 35.33 | 24.06 | 22.22 |
| $v_4s_2$ | 36.33 | 30.00 | 23.04 | 22.89 |
| $v_5s_1$ | 42.00 | 41.33 | 29.62 | 25.67 |
| $v_5s_2$ | 43.33 | 38.67 | 27.97 | 24.33 |
| CD (p=0.05) | NS | NS | NS | NS |

individual plant got access to more space and other resources including sunlight contributing to better growth parameters viz, plant height (Table 1), number of tillers (Table 4). As DMP and nutrient uptake are closely related, high nutrient uptake observed with $S_1$ could be attributed to higher DMP.

**Yield parameters and yield :** Variety $V_5$ recorded the highest grain and straw yield for rabi and summer crops closely followed by ICMV 221( Table 2). The spacing, $S_1$ (30 cm X 20 cm) recorded highest grain and straw yield during both the seasons. Among V x S interactions, $V_5S_1$ recorded significant enhancement with respect to grain yield and straw yield. Significant enhancement in ear head weight of pearl millet was with the variety $V_5$ (34.66 g during *Rabi* and 33.48 g during summer) which can be related with the higher yield. $V_1$ was closely followed $V_5$ in yield performance. The ear head lengths of varieties $V_5$ and $V_1$ were higher and comparable and can be related to their better yield performance. Interaction $V_5S_1$ exhibited significantly higher ear head weight (35.48 g during *Rabi* and 35.90 g during summer) which can be considered as a cumulative effect of the improved individual performance of the treatments. Sumathi et al., (2017) observed CO 10 exhibited better yield performance attributed to its superior genetic traits at Tamil Nadu Agricultural University, Coimbatore. With regard to crop spacing, the better performance of S1 could be well explained on the basis of improved DMP and resultant higher nutrient uptake as detailed above. Srivastava et al. (2015) also observed higher NPK uptake leading to higher yield.

## CONCLUSION

The present study identified CO 10 as the best performing variety in terms of growth and yield under the soil and climatic conditions of southern laterites of Kerala. Crop spacing of 30 cm x 20 cm was found superior with regard to growth and yield. interaction effect of CO 10 ($V_5$) and spacing 30 cm x 20 cm was found promising and hence this treatment combination could be recommended among millet farmers for better prospects in the southern laterites of Kerala.

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