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OPTIMIZING KODO MILLET (*PASPALUM SCROBICULATUM*) YIELD: IMPACTS OF SOWING DATES, ROW SPACING AND FERTILIZER LEVELS

S. Vishwanatha*, B.N. Shwetha, Akshay Kumar Kurdekar, M. Vinay Kumar, G. Ravi Shankar, C. Kavyashree and B.G. Koppalkar

Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Raichur - 584 104 , Karnataka, India.

*Corresponding author E-mail : vishunaik@uasraichur.edu.in

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ABSTRACT

This research paper explores the intricate relationship between kodo millet (*Paspalum scrobiculatum*) grain yield and key agronomic factors, namely dates of sowing, row spacing and fertilizer levels. By investigating the synergistic effects of these variables, the study aims to provide valuable insights into maximizing kodo millet production for enhanced agricultural sustainability and food security. A field experiment was conducted at College of Agriculture farm, Raichur on medium black soil during *kharif*, 2022 to study the effect of date of sowing, row spacing and fertilizer levels on yield and economics of kodo millet (*Paspalum scrobiculatum* L.).

Key words : Kodo millet, Sowing dates, Row spacing, Fertilizer levels, Agronomic practices.

Introduction

Agriculture serves as the backbone of human civilization, providing sustenance and livelihoods across the globe. Within the rich tapestry of cultivated crops, kodo millet (*Paspalum scrobiculatum*) emerges as a vital and often overlooked grain, holding immense potential for enhancing food security and sustainable agricultural practices. As climate variability and population growth place increasing pressure on global food systems, there is a growing imperative to optimize the production of alternative crops like kodo millet, which demonstrate resilience in diverse environmental conditions. Kodo millet, traditionally cultivated in arid and semi-arid regions, exhibits remarkable adaptability to varying agro-climatic conditions. However, to harness its full potential, it is essential to understand and manipulate key agronomic variables that influence its yield. This research embarks on an exploration of the interplay between dates of sowing, row spacing and fertilizer levels a trifecta of factors that intricately shape the growth and productivity of kodo millet.

The choice of sowing date is pivotal in determining the crop's response to environmental cues, affecting germination, flowering, and ultimately, grain yield. Row spacing, another critical determinant, governs the competition for resources among plants, influencing their overall health and productivity. Complementing these factors, fertilizer application levels contribute to the nutritional well-being of the crop, influencing its growth and yield potential. While existing literature provides valuable insights into the individual effects of these factors on various crops, a comprehensive understanding of their combined impact on kodo millet remains elusive. This research endeavors to bridge this knowledge gap by systematically examining the interactive effects of sowing dates, row spacing configurations and fertilizer levels on kodo millet grain yield.

The implications of this study extend beyond the realm of agronomy. By elucidating optimal cultivation practices for kodo millet, the research aims to contribute to broader discussions on agricultural sustainability and food security. As global agriculture faces the dual challenges of climate change and a burgeoning population, diversifying crop portfolios and optimizing cultivation practices become imperative. Through this research, we aspire to provide actionable insights that empower farmers, policymakers, and researchers to enhance the resilience and productivity of kodo millet cultivation, thereby contributing to a more secure and sustainable food future.

Materials and Methods

During the *kharif* season of 2022, a field experiment was conducted at the Agricultural College Farm in Raichur, Karnataka, located within the North Eastern Dry Zone (Zone II) of the state. The experiment employed a split-plot design comprising 20 treatment combinations, each replicated three times. The treatments consist of five dates of sowing as main plots (D_1: first fortnight of July, D_2: second fortnight of July, D_3: first fortnight of August, D_4: second fortnight of August and D_5: first fortnight of September) and four fertilizer levels with row spacing as subplots (F_1S_1: 100% RDF with 30 cm row spacing, F_2S_1: 125% RDF with 30 cm row spacing, F_1S_2: 100% RDF with 45 cm row spacing and F_2S_2: 125% RDF with 45 cm row spacing). Recommended dose of fertilizer was 30:15:15 kg NPK ha^{-1}. Half the dose of nitrogen and entire dose of phosphorous and potassium in the form of urea, diammonium phosphate (DAP) and muriate of potash (MOP) respectively were applied as per the treatments at the time of sowing. Remaining 50 % of nitrogen was applied at 30 DAS. Sowing was done on five different dates (D_1: 15th July, D_2: 29th July, D_3: 12th August, D_4: 26th August and D_5: 9th September). The variety HRK-1 was used for experimentation.

Results and Discussion

Influence of dates of sowing on yield of kodo millet

The grain and straw yield of Kodo millet was significantly influenced due to different dates of sowing (Table 1). Sowing during first fortnight of July recorded significantly higher grain and straw yield (2254.37 and 3889.62 kg ha^{-1}, respectively) followed by crop sown on second fortnight of July (2046 and 3583 kg ha^{-1}, respectively). Late sowing during first fortnight of September recorded significantly lower grain and straw yield (1535.42 and 3008 kg ha^{-1}, respectively). Significantly higher yield in first fortnight of July is mainly due to the increase in yield attributing characters like ear head length (7.29 cm), ear head weight (10.31 g) and test weight (6.71 g) followed by second fortnight of July (7.10 cm, 9.96 g and 6.50 g, respectively). The potential explanation may lie in the fact that the early-sown crop benefited from favorable weather conditions, including optimal temperatures, extended sunshine hours, and moderate relative humidity. These conditions facilitated high levels of light interception and minimized moisture stress, creating a conducive environment for robust vegetative growth. Consequently, the crops were able to fully express their genetic potential, leading to active photosynthesis and enhanced translocation of assimilates to the reproductive parts. This observation aligns with previous studies conducted by Maurya *et al*. (2016), Gavit *et al*. (2017) and Saikishore *et al*. (2020).

Influence of fertilizer levels and row spacing on yield of kodo millet

Yield attributes exhibited significant variations due to variations in fertilizer levels and row spacing, as shown in Table 1. Notably, the application of 125% recommended dose of fertilizer (RDF) combined with a row spacing of 45 cm resulted in the highest ear head length (7.07 cm), ear head weight (9.40 g), and test weight (6.29 g). Following closely, the treatment receiving 100% RDF with 45 cm row spacing displayed respectable values (6.75 cm, 8.93 g, and 6.04 g, respectively). Conversely, the lowest values were observed in the treatment receiving 100% RDF with a row spacing of 30 cm (6.09 cm, 8.01 g and 5.48 g, respectively).

Enhanced yield parameters such as ear head weight, ear head length, and test weight associated with higher fertilizer levels can be attributed to improved growth attributes such as tillers, leaf area, and leaf area index of the crop. This improvement facilitates effective dry matter partitioning and enhanced translocation to the sink, resulting in the formation of more filled grains and larger-sized grains in the ear head, ultimately leading to higher ear head weight, ear head length, and test weight. These findings are consistent with the results reported by Basavarajappa *et al*. (2002), Mubeena *et al*. (2020) and Siddiqui *et al*. (2020).

Plants grown at wider row spacing effectively exploit natural resources, coupled with their responsiveness to externally applied inputs, thereby expressing their maximum potential compared to plants at closer spacing, where competition is more intense. Consequently, wider spacing promotes better partitioning of photosynthates to the reproductive parts. Similar conclusions were drawn by Ram *et al*. (2014) and Kumar *et al*. (2019).

Interaction effects

The interaction effect of dates of sowing, row spacing and fertilizer levels did not exert any significant influence on the yield and yield attributes, of Kodo millet. Despite the variations in these factors, there was no discernible impact on the overall outcomes.

Table 1 : Effect of dates of sowing, row spacing and fertilizer levels on yield attributing characters and yield of kodo millet.

Treatment	Ear head weight (g plant^{-1})	Ear head length (cm plant^{-1})	Test weight (1000 grains)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Date of sowing (D)					
D_1	10.31	7.29	6.71	2254.37	3889.62
D_2	9.96	7.10	6.50	2153.15	3772.42
D_3	9.32	6.56	5.85	1939.72	3549.17
D_4	7.63	6.21	5.35	1732.58	3207.08
D_5	6.15	5.77	4.93	1534.42	3008.00
CD (5%)	**0.57**	**0.66**	**0.54**	**174.54**	**167.04**
Fertilizer levels (F) with row spacing (S)					
F_1S_1	8.01	6.09	5.48	2010.47	3721.73
F_2S_1	8.35	6.43	5.65	2217.25	3961.29
F_1S_2	8.93	6.75	6.04	1597.01	3038.20
F_2S_2	9.40	7.07	6.29	1813.46	3219.80
CD (5%)	**0.51**	**0.60**	**0.27**	**195.42**	**108.93**
Interaction (D × FS)					
$D_1F_1S_1$	9.60	6.90	6.13	2458.67	4074.67
$D_1F_2S_1$	9.78	7.00	6.39	2693.10	4318.13
$D_1F_1S_2$	10.61	7.37	6.91	1808.60	3515.67
$D_1F_2S_2$	11.23	7.90	7.40	2057.10	3650.00
$D_2F_1S_1$	9.46	6.62	5.93	2306.67	4097.00
$D_2F_2S_1$	9.69	6.95	6.14	2546.83	4273.00
$D_2F_1S_2$	10.16	7.24	6.85	1755.77	3265.00
$D_2F_2S_2$	10.55	7.60	7.06	2003.33	3454.67
$D_3F_1S_1$	8.45	6.13	5.68	1987.00	3822.33
$D_3F_2S_1$	8.98	6.41	5.75	2353.00	4079.00
$D_3F_1S_2$	9.60	6.70	5.94	1552.33	3065.67
$D_3F_2S_2$	10.27	6.98	6.01	1866.53	3229.67
$D_4F_1S_1$	7.01	5.56	4.95	1733.33	3445.67
$D_4F_2S_1$	7.30	6.11	5.17	2046.00	3671.33
$D_4F_1S_2$	7.92	6.44	5.58	1460.33	2785.67
$D_4F_2S_2$	8.30	6.72	5.70	1690.67	2925.67
$D_5F_1S_1$	5.52	5.23	4.71	1566.67	3169.00
$D_5F_2S_1$	6.02	5.66	4.80	1717.33	3465.00
$D_5F_1S_2$	6.39	6.02	4.94	1408.00	2559.00
CD (5%)	**NS**	**NS**	**NS**	**NS**	**NS**

Conclusion

Kodo millet sown early in the first fortnight of July exhibited significantly higher yield attributes, including grain yield and straw yield notably, the application of 125% recommended dose of fertilizer (RDF) with a row spacing of 45 cm proved advantageous in terms of individual plant performance. Conversely, utilizing 125% RDF with 30 cm row spacing was found to be economically beneficial, resulting in higher yields. The interaction effect of sowing dates, row spacing and fertilizer levels did not yield significant differences in yield attributes and overall yield.

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