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Estimating the optimum plot size for coconut field experiment

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Coconut stands as a prominent plantation crop in Sri Lanka, contributing to around 12% of the country's total agricultural output, as reported by the Sri Lanka Export Development Board (2021). A significant focus should be drawn towards designing the field research with coconut palms because coconut is a highly heterogeneous perennial crop. The efficient testing of treatment effects in field studies depends on experimental precision. On the other hand, coconut crops show considerable vulnerability to weather and spatial fluctuations. Weather fluctuation affects experimental units depending on the degree of severity, enhancing the yield variability within experimental plots. This causes a high experimental error, masking true treatment effects. Therefore, a proper plot size should be used to treat and handle this uncertainty and improve the coconut experimentation. Remarkably, prior to this research, there was no predetermined optimal plot size for agricultural coconut experiments. Thus, this study bridges this need by carrying out extensive research into the optimal plot size for these experiments. Using optimum plot size helps minimize the yield variation between the individual coconut palms inside a plot. The aim of minimizing yield variance among individual coconut palms is to detect the treatment effects in a precise way. Two methods are available to determine the optimum plot size: The Maximum Curvature Method and Fairfield-Smith's variance law. The Maximum Curvature Method was selected to determine the optimal plot size for coconut experiments, as it has been frequently used for plot size determination in various field crops. The study analysed 26 years of coconut yield data from 1975 to 2000. The method was illustrated using a data set consisting of annual coconut yield from a design-free area at the Coconut Research Institute, Sri Lanka. The coconut palms were 16 years old and belonged to a "tall by tall" coconut cultivar. The obtained optimum plot sizes from the Maximum Curvature Method for coconut vary between four and ten palms per plot for 26 different years. According to the post Runs test, the sequence of optimal plot sizes stable over the years at a significance level of 5%. The results showed that the optimum plot size in coconut field experiments for a huge acreage of agroecological regions is six palms per plot. Thus, the disclosed finding can be defined as the optimum plot size for the Randomized Complete Block Design (RCBD). The practical implications of the result are for resource management, precision agriculture, sustainability, and adaptation to changing conditions. It will also contribute to the existing knowledge base by refining agricultural practices and enabling the integration of technology for improved coconut farming. Result consistency will be enhanced by analysing additional similar datasets and employing variograms to examine spatial fluctuations in addition to the statistical analysis.

Keywords: Heterogeneous, Maximum Curvature Method, Plot Size, Randomized Complete Block Design, Treatment effect