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Genotypic selection approach made successful advancement in developing drought tolerance in perennial tree crop coconut

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ABSTRACT

Coconut (*Cocos nucifera* L.) is a major plantation crop in humid tropics that affects the socio-economic life of several developing countries. Being a rainfed crop, coconut is highly prone to drought and breeding for drought tolerance has become a high priority research. We have identified that selection within populations as the way forward to improve drought tolerance. The current study evaluates the comparative performance of Ambakelle special (AS), a progeny of a within population selection with unselected CRIC60 to identify stable higher yielding palms for future breeding programs. Six-year yield data (2014-2019) from 110 palms in each group were evaluated. Results revealed variety, year and interaction have significant impact on annual yield ($P<0.05$) however, variety x year showed a non-cross-over interaction. AS recorded significant higher mean annual yield (101 nuts/palm/year) compared to CRIC60 (90 nuts/palm/year). Due to low rainfall condition prevailed from July 2016; lower nut yields were recorded for both varieties in 2017 and 2018. However, AS maintained its superiority indicating a better adaptation than CRIC60 under low rainfall conditions. Regression coefficient (b_i) and mean annual yield were used in stability analysis and selected 45 palms as stable and higher yielding genotypes. Out of these 45 palms, thirty-three palms (73.3%) were from AS progeny further indicating the adaptability of AS to varying environmental conditions. Twenty palms (16 AS and 4 CRIC60) were further selected using variance of deviations from the regression (S^2_{di}) and mean kernel weight to be used in the future breeding programs for drought tolerance in coconut.

1. Introduction

Coconut is an important perennial plantation tree crop in many developing countries in the tropics with multifarious uses (Punchihewa and Aroncon, 1999). It plays a significant role in food security & livelihood of people and in the national economy of those countries (Gunasena and Gunathilaka, 2013). With the advent of health benefits of coconut and coconut-based products in the recent past (Prades et al., 2016; Sivapragasam, 2008), there is a very high demand for coconut globally. However, the supply of coconut is limited due to number of reasons (Moreno et al., 2020). Coconut is mainly a rainfed crop thus, occurrence of severe and frequent droughts is a significant contributing factor to reduced yield.

Coconut yield is a complex quantitative trait that varies with the variety, age, environmental factors and interaction between variety and environmental factors. Mature nuts are mainly considered as yield because solid endosperm (kernel) content in nuts is used for the production of a variety of food and is used to extract oil. Among the environmental factors, the climatic conditions, especially the rainfall and the air temperature that affect the viability of pollen and receptivity of female flower, are the major players (Ranasinghe et al., 2015) determining the yield because of its uncontrollable nature under open field conditions (Peiris et al., 2008; Perera, 2015).

One of the major challenges faced by the world in 21[st] century is supplying sufficient amounts of food for the ever-increasing population under the negative impact of global climate change (Lal et al., 2005). Even though several efforts have been made to mitigate the effects of climate change via improving the edaphic factors, development of drought tolerant crop cultivar/s by manipulating the genetic makeup of crops is appeared to be the most sustainable adaptation strategy in climate smart agriculture. As a result, development of drought/heat stress tolerant coconut cultivars has become a major objective of

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