

Reproductive Characteristics of the Selected Cocoa (*Theobroma cacao* L.) Clones after Regenerated from the Somatic Embryogenesis Culture

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Abstract

This study was conducted to evaluate the reproductive characteristics of 4 elite cocoa clones (MCBC1, PBC230, KKM22 and KKM4) propagated via somatic embryogenesis culture. From the findings, all clones have similar reproductive characteristics with clones from conventional grafted. However, only KKM4 clone from immature zygotic embryo culture produced the shortest staminode to style distance of 1.83 mm. This consequently influenced flower stability by reducing the efficiency of pollination by insects. It was found that this clone also has the highest number of flowers drop after anthesis (5 flowers) and lowest production of cherrille (5 cherrilles). Further observation revealed that floral development from first bud visible (BBCH51) to flower anthesis (BBCH68) of all clones took around 31 days. These cocoa flowers which remained receptive soon after anthesis at 10 am (day-31) until the next day (day-32) suggesting 2 days' period of receptivity.

Keywords: Cocoa, Somatic embryogenesis, Reproductive, Pollination, Stigmatic receptivity

Introduction

Achieving an optimal pollination is crucial for the maximum yield in cocoa plant [1,2]. The cocoa plant produced flowers with various staminode to style distances with an average of between 0.05 to 3.00 mm [2]. According to Adjaloo *et al.* [2] the distance between staminode to style is one of a key factor for the successful fertilization of cocoa flowers after pollination process. The staminode to style distances of cocoa flowers were further classified into 3 types based on their arrangement. The type of a style to staminode was converging when their gap was less than 1.20 mm whereas parallel when their gap was between 1.21 to 2.40 mm. The type of staminode to style was splay when their gap was above 2.41 mm. From these, most of the cocoa flowers produced staminode separated from style by less than 2.00 mm [2].

According to Frimpong *et al.* [3] converging and parallel type of staminode to style distances are commonly observed and were also the most ideal flower spatial arrangements for the effective pollination in cocoa plant. This is because such distances offered an intimate contact and more accessible for the pollinating midges which have body size of around 1.00 to 2.00 mm for the deposition of pollen grains [3-5]. It is expected that more pollen grains will be extricated from the pollinator thorax onto the style of the receptive cocoa flowers. The converging and parallel type of staminode to style distances of flowers have been also reported gave the higher fruit set than splay type of staminode to style distance [6].

Apart from staminode and style distance, it is also crucial to study the flower reproductive development for the maximum yield in cocoa plant. Niemanak *et al.* [7] and Bridgemohan *et al.* [8] found that the phenological stages from flower to fruit development can be used to compute and predict the yield of cocoa plant. In addition, the stigmatic receptivity was also imperative in cocoa plant for sexual reproduction and seed formation [9]. This is because the timing and duration of stigmatic receptivity determined the pollination success where pollen grains will only be germinated during active receptive period of stigma [10]. In the other *Theobroma* species such as *Theobroma subincanum*, Souza *et al.* [11] observed that majority of the stigma started to become receptive in the morning of the first day after