

# Fruit setting from natural pollination and the yield of nine-year-old cross-compatible *Cola nitida* clones

J. K. OSEI

University of Ghana Agricultural Research Station, P.O. Box 43, Kade, Ghana

## SUMMARY

Four cross-compatible cola trees were selected from a seedling population, cloned and planted in a polyclonal observational plot. Nine years after planting, the percentage fruit set was measured by observing the proportion of female flowers in thirty inflorescences that set fruit. The range of the fruit set was 5-10 per cent compared with 1-3 per cent for the unselected seedling population. The average yield of the selected clones was about twice that of the unselected seedling population, indicating that compatibility is an important character for selecting for high yield in *Cola nitida*.

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## Introduction

The seeds of *Cola nitida* (Vent) Schott and Endl. have stimulating and sustaining properties due to the presence of some alkaloids including caffeine and theobromine, and are used as a masticatory by the people who live in the hot savanna areas of West Africa. The dried seeds are used in the manufacture of cocacola (Van Eijnatten, 1973). The seeds are harvested from undomesticated trees in the lowland forests of West Africa. Owing to the rapid deforestation occurring in the indigenous area in Ghana, and the increasing demand for colanuts (seeds of *Cola nitida*), collections were made for selection and breeding by ARS, Kade (University of Ghana Agricultural Research Station, Kade).

Studies on the Kade cola collections (Opoku, 1969) and those elsewhere indicate that the yield of mature cola trees is low, ranging from 0 to 300 seeds

## RÉSUMÉ

Osei, J. K.: *Portage de fruit de pollination naturelle et le rendement des clones de Cola nitida de neuf ans ayant un croisement-compatible*. Quatre arbres de kola ayant un croisement-compatible étaient sélectionnés d'une population de semis, clonés et repiqués dans un lotissement polyclonal d'observation. Neuf ans après le repiquage, le pourcentage de fruit porté était mesuré par l'observation de la proportion de fleurs femelles en trente inflorescences qui portent le fruit. L'étendue du fruit porté était 5-10 pour cent comparé avec 1-3 pour cent pour la population de semis non-sélectionnés. Le rendement moyen de clones sélectionnés était à peu près deux fois celui de la population de semis non-sélectionnés, indiquant que la compatibilité est un caractère important de sélection pour un rendement élevé en *Cola nitida*.

per tree per annum with a few trees yielding over 1,000 nuts per annum (Hunter, 1927; Russel, 1955; Van Eijnatten, 1973). Full bearing is reached after 15 years (Russel, 1955). The average yield of mature unselected tree is about 250 seeds per annum (Van Eijnatten, 1962).

The low productivity of cola trees has been attributed to self-incompatibility and varying levels of compatibility that limit fruit setting in unselected cola trees (Jacob & Okoloko, 1974; Osei, 1987). Using hand pollination, Osei (1978) found some trees among the Kade collections to be highly compatible in reciprocal combinations. If natural pollination is effective, a mixture of clones derived from these cross-compatible trees should set fruit readily in a plantation, and thereby produce high yields. This paper reports on the percentage fruit set from natural pollination and the yields of 9-year-old clones derived from four cross-compat-

ible trees among the Kade collections, and discusses methods for improving yield of the cola tree.

### Materials and methods

A polyclonal observational plot planted at ARS, Kade in June 1984 was used for the study. The clones were derived from cross-compatible trees among the Kade cola collections that gave 30-50 per cent fruit set when intercrossed in all possible combinations (Osei, 1978). During the flowering season in September 1993, three trees each of the clones K1/9, R13, R17 and W20 were used for the determination of the percentage fruit set from natural pollination. This was done by observing proportion of female flowers in 30 inflorescences on each tree that set fruit 3 weeks after flower opening. The yields of colanuts of the trees used in the determination were recorded during harvesting period from December 1993 to January 1994.

### Results and discussion

Table 1 shows the average number of female flow-

Twenty to 40 per cent of the inflorescences and 5 - 10 per cent of the female flowers set fruit. This is higher than the assessment by Bodard (1962) that one fruit set naturally from every 100 opened cola inflorescences. It is also higher than the observation by Brew (1993) that 3.4 per cent of female flowers set fruit in mature unselected cola trees. However, the level of fruit set observed in this work was much lower than the 30-50 per cent fruit set obtained from artificial pollination (Osei, 1978; Van Eijnatten, 1967). This indicates that the pollinating insects, which have not yet been identified, were inefficient compared to artificial pollination, probably because their population level was low during the flowering period.

Almost all the fruits that set reached harvest maturity as indicated by the percentage of female flowers that reached harvest maturity (Table 1). Few developing fruits that failed to reach harvest maturity were damaged by fruit flies and capsids, but not by cherelle wilt, the physiological fruit thinning mechanism that prevents over-bearing.

TABLE 1

*Fruit Setting from Natural Pollination and the Yields of 9-year-old Cross-compatible Cola nitida Clones*

<i>Clone</i>	<i>Av. no. of female flowers in 30 inflorescences/tree</i>	<i>Percentage of inflorescences with fruit set</i>	<i>Percentage of female flowers that set fruit</i>	<i>Percentage of female flowers reaching harvest maturity</i>	<i>Av. yield (no. of cola nuts per tree)</i>
W20	324	33.3	6.5	5.0	860
R13	225	20.0	5.3	5.3	563
K1/9	238	33.0	9.7	8.0	375
R17	220	43.0	10.3	9.6	282
Mean	252	32.4	8.0	7.0	520

ers in 30 inflorescences per tree of the four clones studied, the percentage fruit set from natural pollination, the percentage of the flowers that reached harvest maturity, and the average yield per tree of each of the four clones.

Conditions for natural pollination during the study were very good because flowering was synchronous and heavy, and adequate number of male and female flowers were produced by all the clones.

The average yield per tree of the four cross-compatible trees was about twice the expected yield of mature unselected cola trees. Despite the inefficiency of the natural pollinators, the levels of fruit set was adequate to produce very good yields. This is evidence that compatibility is an important character for selecting for yield in *Cola nitida*. The clones have not reached their peak production. Higher yields are expected in subsequent years.

The average yields of clones W20 and R13 were higher than those of K1/9 and R17, although the latter clones had higher percentage of female flowers that set fruit. Clones W20 and R13 have bigger stature than that of clones K1/9 and R17. The low percentage fruit set on clones R13 and W20 was overcompensated for by the higher number of inflorescences produced on them.

Cola inflorescences are produced from axillary buds on new flushes (Osei, 1987); therefore, in addition to compatibility, genotypes which have greater capacity to produce new flushes prior to flowering may be selected for improvement, provided that a dwarfing rootstock is available to clone them, so that their fruits may be within easy reach for harvesting. For this purpose, F1 progenies of the small statured clones K1/9 and R17 are being tested for their suitability as rootstocks for clones W20 and R13.

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