Pollination of Coffea Arabica L. and Associated Awareness of Pollination Significance among Farmers in Selected Farms in Kiambu District, Kenya

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ABSTRACT

Kenyan coffee (*Coffea arabica* L.) is rated among the best quality coffee produced worldwide. Unfortunately, there has been a decline of coffee production and inadequate pollination is suspected to be among the contributing factors. This was the first study in Kenya to investigate on the pollinators of coffee, the role of natural floral resources as alternative floral resources, importance of pollination in improving coffee yield and cup quality, efficiency of some key pollinators of coffee and pollination knowledge among coffee farmers.

Two farms were selected for the study based on management practices; in one farm organic farming was practiced while in the other conventional practices were carried out. Two transects each 1.5 km were selected per farm and plots of 100m2 laid within the two transects. Bees that visited coffee and other plant flowers were sampled. Observation of bee foraging behaviour and the resources collected was recorded. Investigations on the effects of pollination levels on fruit set and retention was analysed. Pollination knowledge of coffee farmers was assessed using a semistructured questionnaire and a knowledge index assigned.

In total, bees from 63 families were recorded as pollinators of coffee with a record of 60 species in the organic farm and 24 species in the conventional farm. Bee abundance and diversity were significantly higher in the organic than in the conventional farm (P<0.05). During the study period, *Andrena* spp. a rare bee species not previously described in Kenya was collected from the organic farm.

A total of 42 plant species represented in 19 plant families formed natural floral resources in coffee farms and the surrounding areas. The organic farm recorded all the 19 plant families and 40 species. The conventional farm had 25 plant species from 14 families. A highly significant relationship (P<0.0001) existed between natural vegetation richness and the bee richness.

This study provided evidence that coffee requires pollination for enhanced yields, heavy berries and high cup quality. Significant differences (P<0.001) existed between the percentage fruit set, fruit retention (t= 49.258, P<0.001), berry weight (P< 0.001) and the average cup quality (P<0.001) between autogamy and different pollination levels. Open pollination which encompassed pollinators, wind and autogamy produced the best quality coffee while the lowest quality was recorded from autogamy.

Peak foraging time of bees coincided with the time of high nectar volume and average nectar sugar concentration. There was a positive significant correlation (P<0.01) between the average time taken on a flower and the number of flowers of the same plant foraged on and a negative significant relationship (P<0.05) between percentage flowering and the number of flowers foraged on per plant.

Among the sampled bee species solitary bees *Patellapis (Zonalictus* spp.*)* and *Lasioglossum* spp. deposited higher numbers of coffee pollen grains while *Apis mellifera* L. had the highest number

of non coffee pollen hence the former could be more efficient pollinators of *C. arabica*. Significant differences in both the pollen deposited and pollen purity occurred between *A. mellifera* and *Patellapis zonalictus* (p<0.001) and *A. mellifera* and *Lasioglossum* spp. (P<0.001). This finding calls for enhancement of diverse populations of solitary bees for more efficient pollination.

Coffee farming was dominated by males (84%) with only 16% female farmers. Male farmers had a higher pollination knowledge index than female farmers but the differences were not significant (p>0.001). The differences in pollination knowledge between education level groups were not significant (P>0.001). This indicates that education on pollination issues should be done across all education levels and both genders.

This study concludes that biotic pollination is important in enhancing yields and the quality of coffee without additional farm inputs. Further, other relatively unknown bees are more efficient in pollinating coffee than the relatively more popular agricultural pollinator *A. mellifera*. Pollination knowledge among farmers is limited and outreach systems and extension services should be used to disseminate this knowledge.