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Assessment of berry drop due to coffee berry disease and non-CBD factors in Arabica coffee under farmers fields of Southwestern Ethiopia

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ABSTRACT

To evaluate the effective impact of Coffee Berry Disease (CBD) on berry loss in the smallholder context of SW Ethiopia, CBD symptoms were monitored during the rainy seasons of two consecutive years on both protected (with fungicide applications) and unprotected coffee branches. Fungicide applications (mancozeb) had significant effect (**P** < 4e-05) on the proportion of necrotic and dropped berries; CBD necrotic symptom was reduced from 48.7% (non treated) to zero (treated) while berry drop was reduced from 52.8% (non treated) to 40.8% (treated), suggesting that only 12.1% of the observed berry loss could certainly be attributed to CBD. Disease incidence was not influenced by the branch position in the canopy of the monitored trees. Altitude was an important factor controlling the disease incidence as it favored the development of both necrotic and drop symptoms. The result suggests that non-CBD factors controlling the physiology of berry production, such as plant age, pruning or soil fertilization, climate are predominant in the studied context to explain yield loss, and that berry drop symptom assessment alone may lead to an overestimation of CBD impact.

1. Introduction

Coffee (*Coffea arabica* L.) is one of the most important commodities in the international agricultural trade, representing a significant source of income in many tropical countries. In Ethiopia, diseases are the main production constraints (Ameha, 1989; Derso et al., 2000; Zeru et al., 2009). Berry anthracnosis (Coffee Berry Disease; CBD) is one of the most damageable, responsible for an estimated average yield reduction from 24% to 30% (Derso, 1997). A number of *Colletotrichum* species responsible for anthracnosis are isolated from coffee (*C. gleosporioides, C. kahawae, C, acutatum*), but *C. kahawae*, the causal agent of CBD, is the only one generating damages to berries; the fungus is responsible for dark sunken lesions and sporulation, causing tissue necrosis, premature dropping and mummification (Masaba and Waller, 1992; Waller et al., 2007; Biratu, 1995). Although aggressiveness among *C. kahawae* isolates may vary, no host specialization (physiologic races) in the CBD pathogen populations in Ethiopia has been reported (Biratu, 1995; Derso and Waller, 2003; Zeru et al., 2009).

Susceptibility of coffee berries to CBD is higher during fruit expansion (9–17 weeks after flowering) and endosperm growth (18–25weeks) as compared to earlier and later stages, respectively pinhead (1–8weeks), endosperm hardening (26–32weeks) and ripening stage (33–37 weeks). Young, small berries appear resistant to CBD; during the growth phase, the physiological resistance to the disease decreases to become minimal at the last stage of growth, while during the maturation stages resistance to the disease is restored (Mulinge, 1970; Gassert, 1979; Yilma et al., 1997; Waller et al., 2007; Mouen Bedimo et al., 2007, 2010). Susceptibility of berries to CBD is also affected by other factors including altitude, initial number of berries produced per branch and agronomic practices (Cook, 1975; Van der Graaff, 1981; Vaast et al., 2005; Zeru et al., 2009). Altitude affects the susceptibility of coffee berries to CBD by influencing the weather conditions of the area. Higher amount of rain, high air humidity, and relatively low temperatures favor disease development. These conditions prevail at high altitudes areas where the disease is invariably severe (Mulinge, 1971; Van der Graaff, 1981). Initial number of berries produced per branches affects the susceptibility of coffee berries to CBD by reducing their resistance to the disease. Heavy fruit load significantly reduces berry dry mass (Vaast et al., 2005), which makes the berry more susceptible to the disease (Waller, 1985). Berries on the leafless parts of branches, near the main trunk of the

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coffee trees, are less infected by CBD than those on leafy sections (Mouen Bedimo et al., 2007). Measures to enable adequate aeration of the coffee canopy such as pruning, shade control and adequate spacing reduce humidity and wetness duration of berry surfaces and, to some extent, hinder the pathogen development (Waller et al., 2007); irrigation during the dry season may also facilitate CBD control: the practice generates an escape mechanism to CBD infection, as irrigated coffee plants flower sooner and the berry maturation process is initiated prior the unset of climate conditions (rainy season) favorable to CBD (Muller et al., 2004). Shading has been reported to impact coffee berry disease severity (Mouen Bedimo et al., 2007; Mouen Bedimo et al., 2008) as the proportion of diseased berries was significantly higher on coffee trees exposed to sunlight. Shading creates microclimatic conditions that helped to delay fruit ripening (Vaast et al., 2006), which might have led to a shift in the period of berry susceptibility (ripening stage) outside the period of high disease pressure (rainy season). The effect of shade could also consist in a change of rainfall characteristics, which might reduce conidial dispersal. Coffee trees interplanted with fruits trees were less infected than coffee trees in a monoculture (Phiri et al., 2001; Mouen Bedimo et al., 2008). Therefore, maintenance pruning, removal of mummified berries, and mixed cropping with shade plants are cultural practices that create environmental conditions limiting CBD development.

At initial stages of coffee berry development process, immediately after the flowering stage, non-CBD factors involved in plant nutrition and vigor regulation (such as climate, fertilization and other agronomic practices) are considered predominant to explain the observed proportion of immature berry abortion (Barros et al., 1999 as cited by DaMatta et al., 2007; Anand et al., 2014). At later stages, they are considered of minor importance (Griffiths et al., 1971) and are frequently ignored while assessing CBD impact as the proportion of fallen berries. However, previous work (Muller, 1982) reported the risk of over estimation of CBD-induced berry drop symptom if the occurrence and effect on non-CBD factors on berry drop dynamic was underestimated. Ignoring the influence of non-CBD factors would lead to address the issue of berry drop only from a disease control perspective, an approach that would only partially address the problem. The objective of this work was to obtain an unbiased evaluation of coffee berry loss due to CBD in the smallholder context of South West Ethiopia, where coffee management is minimal if not absent. This would help define the cause of low coffee yield in the studied area and help design adapted recommendations to farmers to improve coffee production performance.

2. Materials and methods

2.1. Study site

The trial was carried out in Southwestern Ethiopia at Ageyo-Setema research site (100 km in the Northwest of Jimma town) 08°04″19′N, 36°47″04′E within altitudes ranging from 1505 to 2124 meters above sea level (Fig. 1). The coffee produced in the study area is exclusively *Coffea arabica* and the coffee trees used for the study were local susceptible landraces. The local rainfall pattern of the study site is nearly mono-modal, with a main rainy season from June to August, inducing a single coffee crop harvest season from October to December. The topography of the area is undulating landscape that consists of a mosaic of crop land, pasture, natural forest fragments managed for coffee production and isolated farmsteads, and patches of plantation forest planted with exotic timber tree species (Cupressus and Pine species). Coffee plots are generally small, less than 0.5ha, always grown under shade trees from the initial natural forest, mainly *Albizia gummifera*, *Cordia africana*, *Millettia ferruginea*, *Croton macrostachyus*, *Acacia abyssinica*, *Ficus vasta*, *Ehretia cymosa*, *Dracaena steudneri* and *Vernonia amygdalina*. Coffee field management, namely, slashing of the

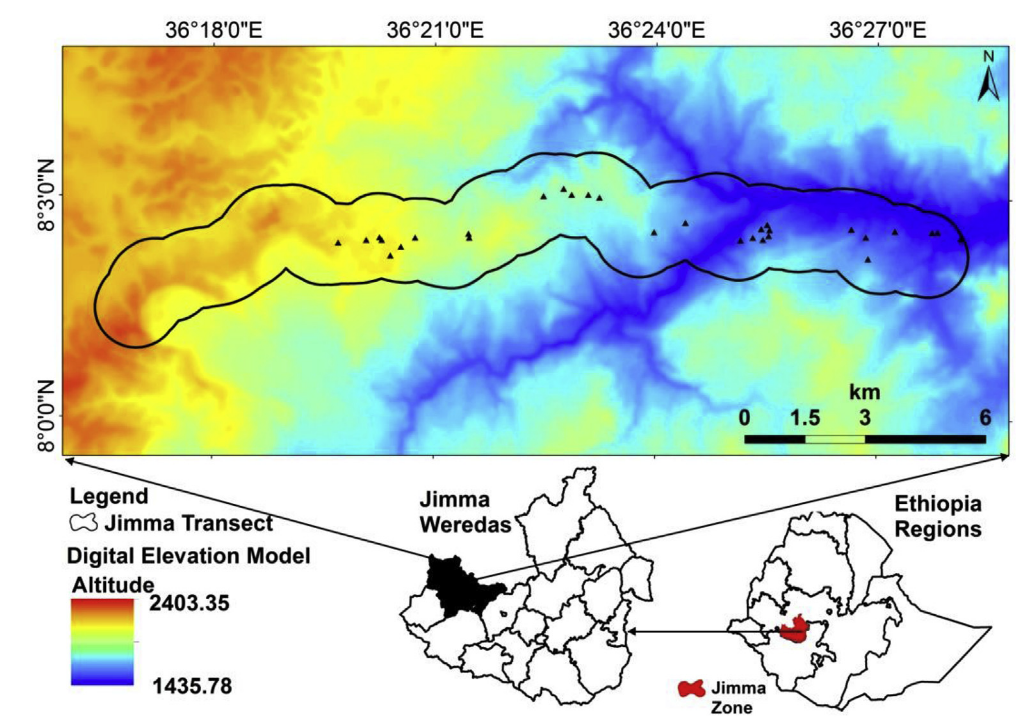

Fig. 1. Map of the study area: Ageyo-Setema research site (Triangle shaped dots: trial sites/coffee plots).

understory shrubs and weeding, is done once or twice per year, two weeks before harvesting the berries. Farmers do not fertilize nor apply any other chemical input on their coffee farms.

2.2. Trial design

To obtain an unbiased evaluation of coffee berry loss, we implemented a protocol including applications of a protectant fungicide (mancozeb; Dow Agrochemical, 2016) to partitioned CBD and non-CBD factors controlling berry drop symptom; CBD development dynamic was monitored on both fungicide protected and non-protected branches, the observed difference being theoretically attributed to the disease development. Such approach assumes high level or complete protection against CBD attacks of berries that received fungicide applications. During the trial implementation, this assumption appeared acceptable; its validity is discussed in the last section of this paper. It was further envisaged that the mechanism leading to berry drop could also be influenced by a branch effect due to the age or the position of the branch on the main stem. To avoid this bias in our estimation, the trial was built over a two-year period. In year one, no fungicide was applied and all selected branches were kept un-protected. The branch effect on berry fall dynamic was tested to confirm (or invalidate) the independence of berry fall expression with regards to the rank of the monitored branch; in year two, the trial sample was divided in two equal subsamples; the first one did not receive any fungicide treatment and the branch effect was again tested in the specific climatic conditions of the second year. On the second subsample, one branch from each tree received mancozeb protection while a second branch from the same tree remained unprotected from CBD infection. Berry fall dynamics from both branches types were further compared. Doing so, any genotypic effect on berry fall development that could have eventually interfered with our observations was removed from the analysis, as all protected and non-protected branches belonged to the same tree population.

Observations were made in 2012 and 2013 from May to October in order to capture CBD development during the wet and cold rainy season. In 2012, thirty shaded coffee plots of 20 m × 20 m were selected to capture the altitude variability along the transect (Fig. 1). In 2013, a subset of 24 coffee plots was selected from the initial sample (since six plots were used for other trial). In both years, the flowering dates of the coffee trees were recorded.

In 2012, ten coffee trees from each coffee plot were randomly selected for coffee berry loss assessment. On each coffee tree, two primary plagiotropic branches, one from the upper and the other from the lower canopy layer of the coffee trees were selected during the dry month of May when berries were at the pinhead stage, before any visible symptoms of CBD infection could be detected. On each branch, all berry-bearing nodes were marked for further observation.

In 2013, to partition the cause of berry drop into CBD and non-CBD factors, mancozeb protective fungicide treatment was selectively applied to prevent CBD infection. On five randomly selected coffee trees per plot (out of the 10 trees selected in 2012), the lower branch was protected with mancozeb applications ("protected branch of treated tree") while the upper branch was kept non-protected for comparison purpose ("non-protected branch of treated tree"). The treatment of lower branch was justified by the fact that spraying the upper branch may have resulted in mancozeb leakage on the lower branch, thus affecting CBD incidence on this branch. One liter of mancozeb solution (0.4 g/liter water) was used to treat 20 branches every two weeks interval, according to the recommendation of Derso et al. (2000), starting from the last week of May (six weeks after flowering) to last week of September 2013. The five remaining trees per plot were left untreated as control.

2.3. Data collection

2.3.1. Initial number of berry

Six weeks after flowering, when most of the immature berries had fallen (Griffiths et al., 1971), each bearing nodes from the selected branches was labeled; the number of berries from each node was counted and recorded as initial number of berry.

2.3.2. Number of diseased and remaining berry

The numbers of remaining berries (diseased + healthy) and infected berries present on each node were recorded (i) five times in 2012, once every month, at 11, 16, 20, 25 and 29 weeks after flowering, i.e., 30, 60, 90, 120 and 150 days after the first observation (mid of May); (ii) six times in 2013, beginning 10 weeks after flowering and then at 13, 15, 17,19 and 23 weeks after flowering (i.e., at 30, 45, 60, 75, 90 and 120 days after the first observation (last week of May)). The number of dropped berries at each observation date was calculated by taking the difference of the initial berry from the remaining berries.

2.3.3. Other disease observation

Considering that other coffee disease impact may interfere with our observations on CBD, a rapid survey (including interviews of local agriculture officers) was conducted in the trial sites to assess for the presence of any other diseases such as root disease (*Fusarium solani*) or vascular disease (*Fusarium xylarioides*) that are known to be present in Ethiopia and known to influence coffee bearing. None of these diseases were detected in the studied environment.

2.4. Data analysis

Data analyses were conducted to detect a possible altitudinal effect on the development of observed symptoms such as berry fall and berry infection. A possible branch level effect on the symptoms' expression due to the branch position on the main stem was also tested. As mancozeb application effect may be confounded with the branch level factor, the berry drop symptom incidence on lower and upper branches at the final date of the assessment were compared from both treated and non-treated trees in 2013 to possibly isolate the fungicide effect from the branch level effect on berry drop symptom.

Based on General Linear Model (GLM) procedures, analysis were implemented at branch level after summing the various observation made at node level, i.e. initial berry number, number of healthy berries and number of infected berries observed for each year separately. Preliminary analysis of the data revealed signs of overdispersion of the dependent variables. Therefore, initial number of berries was analyzed using GLM procedures based on quasi-Poisson distribution law of variance (*initial berry number = GLM(branch level + Altitude)*), while GLM procedure based on quasi-binomial distribution of variance was implemented to analyze berry drop and berry infection symptoms *Berry Drop Proportion and Berry Infection Proportion explained by GLM(branch level + Altitude) and GLM(fungicide treatment + Altitude)*.

Berry drop dynamic analysis was implemented on 2013 observations using a general linear mixed model procedure of quasi-binomial distribution to test the symptom evolution over time The model was fitted by maximum likelihood and mixed model was used to consider the repeated measurement of the observation from the same plant at different dates. For such analysis, individual coffee trees were considered as random effect (*Berry Drop Proportion = GLM_mixed (Date + random(tree))*). All statistical analysis was performed using lme4 package from the R programming environment (2.15.1 version).

3. Results

3.1. Initial berry characterization

In 2012, results showed that branch had no significant effect (***P*** = 0.908) on the initial number of berry produced while altitude had (***P*** = 2e-16). On average, 38.2 and 37.9 berries were observed on upper and lower branches, at the first date of observation (May 2012) (Fig. 2A). Coffee plots located at the top of the transect had greater number of initial berries per branch as compared to the coffee plots located at lower part of the transect. In 2013, on fungicide-treated coffee trees, no effect of both altitude (***P*** = 0.228) and branch (***P*** = 0.868) was detected on the initial number of berries (Fig. 2B). On non-treated coffee trees (Fig. 2C), altitude had a weak but significant effect on initial number of berries (***P*** = 0.0498) while branch factor had no significant effect still (***P*** = 0.5834). When both treated and non-treated 2013 samples were compared in a single analysis, the branch, treatment and branch-treatment interaction effects on the number of initial berries were non-significant (***P*** > 0.6); altitude did not generate any effect while treatment and altitude-treatment interaction effects did (***P*** = 0.017 and ***P*** = 0.024).

3.2. Berry drop analysis

3.2.1. Branch position influence

In 2012, at the last date of observation, the effect of branch position on the proportion of dropped berries was non-significant (***P*** = 0.273) (Fig. 3A). Similarly, in 2013, on coffee trees that had not received mancozeb application, the branch position did not generate any significant effect (P = 0.187) on the proportion of berry drops (Fig. 3C). However, branch had a significant effect (***P*** = 7.17e-11) on the proportion of berry drops on coffee trees that had received mancozeb application (Fig. 3B).

3.2.2. Altitude influence

Altitude strongly influenced the proportion of berry drops (Fig. 3) both in 2012 (***P*** = 1.81e-10) and 2013 observations (***P*** = 2.29e-12 for non treated trees; ***P*** = 0.0018 for treated coffee trees) as berry drops incidence increased with higher altitude. In 2012, averaged berry drop incidence increased from 35% at 1505 m to 53% at 2124 m (Fig. 2A); in 2013, on non-treated tree, averaged berry drop incidence increased from 43% ate 1505 m to 76% at 2124 m (Fig. 3C).

Furthermore, the percentages of berry dropped (average of 120 branches; five branch from each plot ×24 plots) both on protected and non-protected branches varied significantly (***P*** < 0.05) with the date of observation in 2013 (Fig. 4). There was an increasing trend of berry drops over time; from 29.4 to 40.7% on protected branch and 26.9–52.8% on non-protected branches, from June to September (Fig. 4). At early stages of data collection (June and mid July), berry drop proportions were similar on both protected and non-protected branches while at the end of data collection (last week of September), berry drop was 12.1% greater (52.8%–40.7%) on non-protected coffee branches as compared to mancozeb protected coffee branches.

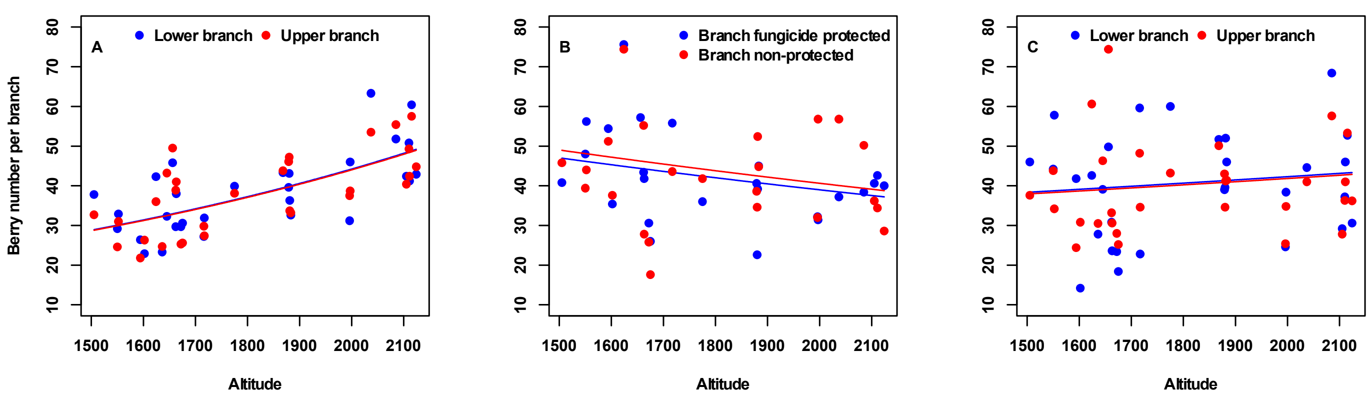

Fig. 2. Average berry number per branch and per plot at the beginning of the observation period over Ageyo-Setema altitudinal gradient. A: May 2012; B: May 2013, fungicide treatment; C: May 2013, non-treated trees.

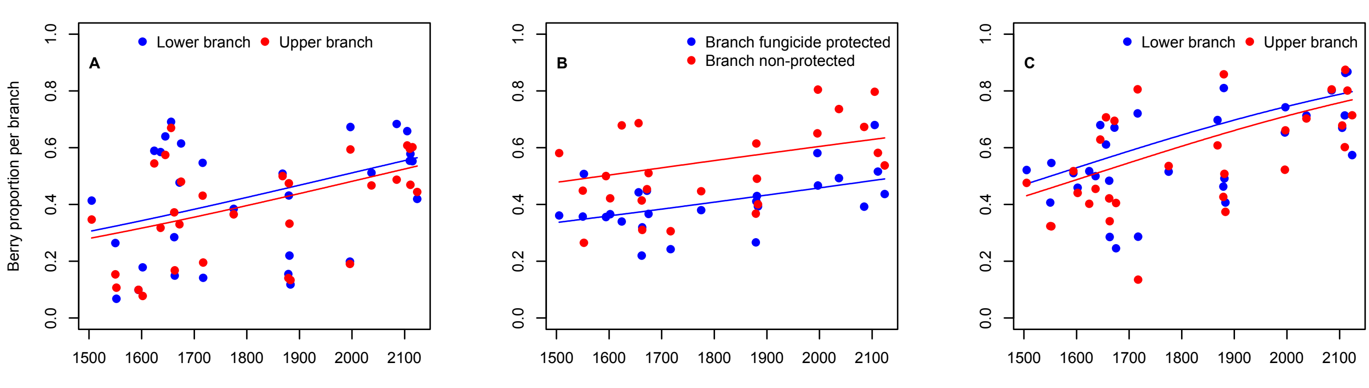

Fig. 3. Average proportion of berry drop symptom per branch and per plot at the end of the observation period along Ageyo-Setema altitudinal gradient. A: October 2012; B: September 2013, fungicide treatment; C: September 2013, non treated trees.

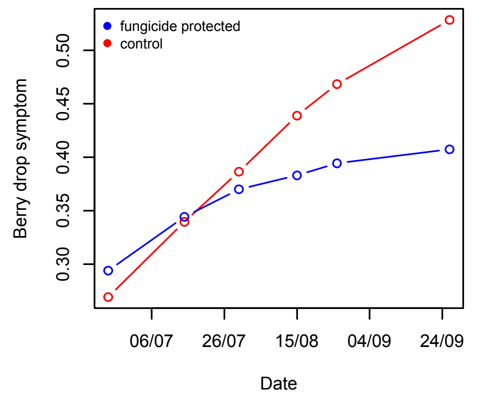

Fig. 4. Berry drop symptom dynamic on both fungicide protected and non-protected branches in Ageyo-Setema area in 2013; averaged observations from 5 branches x 24 plots per date; observation date at 30, 45, 60, 75, 90 and 120 days after flowering.

Fig. 6. CBD necrosis symptom on green berries (15 weeks after flowering): Fungicide protected branch (branch that has healthy berry; upfront) and non-protected branch (branch that has diseased berry; background) (Photo: Garedew W., 2013).

3.3. Diseased berry analysis

3.3.1. Branch position influence

In 2012, at the last date of observation, the effect of branch on the proportion of diseased berries showing CBD necrosis symptom were non-significant ($\boldsymbol{P} = 0.452$) (Fig. 5A). In 2013, similar result was obtained on non-treated coffee trees ($\boldsymbol{P} = 0.224$) (Fig. 5C). However, on 2013 treated coffee trees, the effect of branch on the proportion of diseased berries was highly significant ($\boldsymbol{P} = 1.84\text{e-}05$) (Fig. 5B) due to the very low level of symptom expression on chemically protected berries (Fig. 6); on protected branches, as low as 0.4% of CBD necrotic symptom was observed (13 infected berries detected out of 3008 observations) while a maximum of 48.7% necrotic berries per plot was recorded on non-protected coffee branch (Fig. 5B).

3.3.2. Altitude influence

Altitude strongly influenced the proportion of diseased berries both on treated and non-treated coffee trees in both years (Fig. 5.); in all cases, the higher the altitude, the greater the number of diseased berries observed. In 2012, the percentage of diseased berries per plot varied from 2.4% at the lowest portion of the transect to 86.9% at the highest location (Fig. 5A). In 2013, on the non-treated coffee trees, CBD incidence varied from 0% to a maximum of 68.8% (Fig. 5C). However, the detected 0% of infection means that the diseased berries had already fallen at the date of observation.

4. Discussions

This work demonstrated that protective fungicide applications (mancozeb) prevents from CBD necrotic symptom occurrence and reduces the proportion of berry drop symptom by a significant 12.1%. On fungicide-protected branches, berry drop incidence remained high and this observation is attributed to non-CBD factors, most likely physiological ones, resulting from plant nutrition problem or ill management practices (possibly interacting with climate conditions). Such reasoning is based on several assumptions including (i) the full efficiency of mancozeb to prevent from CBD symptom expression; (ii) the absence of other disease than CBD, not controlled by mancozeb applications, that may generates berry drop; (iii) the absence of a branch level effect that may be confounded with the mancozeb treatment effect and, (iv) the expression of physiological factors responsible for berry drop at late stages of the berry maturation process. These four assumptions are discussed below.

(i) *Colletotrichum kahawae* is a necrotrophic parasite, which penetration of the berry skin rapidly produces black, expanding necrotic area due to the death of infected berry cells. Berries may also be shed as soon as such active lesion

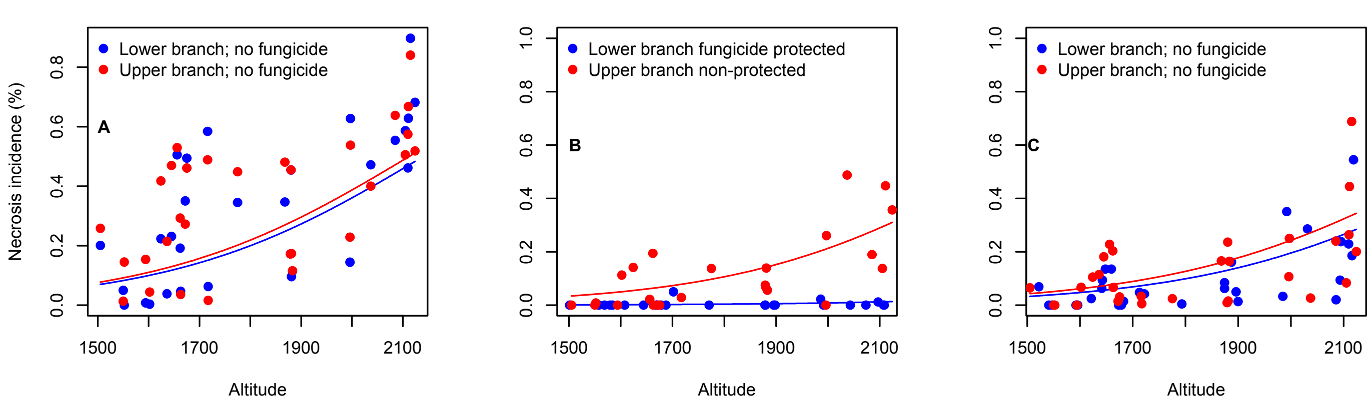

Fig. 5. Average proportion of CBD necrosis symptom per branch and per plot at the end of the observation period. A: October 2012; B: September 2013, fungicide treatment; C: September 2013, non treated trees.

develops (Masaba and Waller, 1992). Unlike other anthracnosis agent such as *C. musae* on banana or *C. gloeosporioides* on avocado (Prusky and Plumbey, 1992), *C. kahawae* has no known quiescent biological stage and no cryptic development phase that could induce symptom such as berry drop through distant action (through toxin production for example) (Masaba and Waller, 1992). We therefore assumed that the absence of necrotic spot at the berry surface could be interpreted as the absence of infection at the date of observation. However, formal demonstration of this assumption would require further cytological investigation of symptomless berries, to confirm the absence of fungal colony in the berry tissue, which could not be implemented in this study. Mancozeb belongs to the dithiocarbamate fungicide family that inhibits the synthesis of the fungal membrane lipids; it is a broad-spectrum, non-specific, fungicide recommended as an efficient protectant for the control of a large number of vegetable and fruit tree diseases (Dow Agrochemical, 2016). To optimize mancozeb efficiency, our trial included frequent and regular applications. Such treatment led to the complete absence of necrosis development on the berry surface during the first 80 days of trial implementation. At the end of the trial period, 19 and 23 weeks after the beginning of observations, only few necrotic symptoms could be detected after careful visual examination of the remaining berries (13 infection cases out of 3008 observations, equivalent to 0.4% incidence). From this, we concluded that mancozeb could be considered as fully efficient to prevent CBD development on the treated berries.

(ii) It could be argued that other disease(s) than CBD induced the observed berry fall. According to our protocol, such disease(s) should be either resistant to mancozeb inhibition or systemic (meaning that they could induce symptom on treated branches from a distant, non-protected, infection site). Only few pathogens could be suspected to be able to do so on coffee: root disease and vascular disease, but, to our knowledge of the trial context, they were absent from the experimental sites. Therefore, the impact of other diseases than CBD was not considered to explain the difference in symptom incidences in our trial.

(iii) Mancozeb applications were always done on primary branches of the lower part of the coffee canopy while non-protected branches were always from the higher part. Thus, it can be suspected that a branch level effect could have been confounded with the mancozeb treatment effect. Our protocol included in both years a comparison of CBD symptoms incidence on non-fungicide protected branches from various levels. No difference was observed regarding the number of initial berries and the disease symptoms incidence, leading to the conclusion that CBD symptoms incidence was independent of the level of the monitored branches. The hypothesis of branch level and mancozeb confounded effects was therefore invalidated, in agreement with previous report from Cameroon where the non-significant effect of branch position (upper, middle and lower part of the canopy) on the percentage of physiological shedding of berries was also observed (Mouen Bedimo et al., 2010).

(iv) Berry drop is a common phenomenon that occurs in coffee, which may be of various origins: physiological dysfunction, diseases, insect pests or climate events (Cannell, 1985; Vaast et al., 2005; Anand et al., 2014). It is usually considered that physiological factors are mostly effective till the pinhead stage of berry development, some 8 weeks after flowering development (Griffiths et al., 1971) other reports indicate that such factors could be effective over a longer period, as long as 12 weeks after flowering (Barros et al., 1999 as cited by DaMatta et al., 2007; Anand et al., 2014). Observations from Cameroon (Mouen Bedimo et al., 2007, 2010) and Kenya (Waller, 1971) even mention the possibility of physiological berry drop till 24 weeks after flowering, responsible for as much as 30% (resp. 43%) of berry loss. All these reports indicate that physiological weakness is not limited to specific berry development stages but, instead, seems to be expressed throughout the berry developmental process and responsible for various amount of berry drop according to the specific characteristic of the crop environment.

Based on these assumptions, we interpret our observation on coffee berry loss as mainly the result of physiological disorders induced by unbalanced production conditions, leading to coffee tree weakness, exhaustion and, finally, fruit drop, according to a mechanism described by plant physiologists (Cannell, 1985; DaMatta et al., 2007). Extended dry period after fruit set, soil saturation effect, hormonal imbalance and insufficient assimilate supply to developing berries at the early berry development stage were reported as some of non-CBD factors that contribute to berry drops in coffee (Anand et al., 2014). The information is critical to farmers and extension officers as it changes the nature of the problem they have to address to reduce crop losses and to increase coffee productivity. In order to reduce berry drop incidence, priorities should be given not only to disease control measures (although important) but should also address the agronomic practices issue, aiming at improving plant nutrition (fertilization, manure application, mulching) and plant management (replanting, pruning and stumping), in order to restore balanced growth of the current weakened plants. In Agayo-Setema context, restoring vigor of the coffee orchard thus appears as a critical objective to reduce significant production losses. This would require the plantation of new CBD resistant coffee seedlings to replace the numerous old and CBD susceptible trees, planted more than 25 years ago, which have limited potential for rejuvenation. It also implies the correct implementation of good agricultural practices to keep the young coffee trees in a suitable production configuration (with limited number of primary and secondary stems). Such measures would greatly improve the yield of the production system, thus improving farmers' revenue. They would also generate greater resilience of the orchard and capacity to better resist adverse conditions such as extreme climate events.

Altitude positively influenced both CBD infection (berry drop and berry necrotic symptoms) and physiological drops. Altitude effect is considered as indirect as it is the climate conditions associated with altitude, which are more directly involved in the control of berry infection dynamic. CBD expansion is favored by cool (17 °C–22 °C) and humid conditions close to saturation (Nutman and Roberts, 1960; Van der Graaff, 1981) more likely to occur at high elevation (Griffiths et al., 1971), thus explaining the greater incidence of CBD in the upper part of the studied transect. Our results agree with these considerations. They also suggest the greater physiological susceptibility of Arabica coffee tree to cold and humid conditions, leading to an increased number of berry drops of physiological origin.

5. Conclusion

In the context of Agayo-Setama transect, in Jimma region, Southwestern part of Ethiopia, our results indicate two important causes of berry loss and yield reduction: CBD infection and physiological weakness of the coffee trees. The later origin is predominant, but is too frequently ignored by producers and extension officers who attribute berry drop symptom to CBD. The same situation may prevail in other producing area of Ethiopia and needs confirmation. Wrong estimation of the real importance of CBD incidence could lead to inappropriate development strategies, missing to address other important problem than CBD like physiological weakness of the coffee orchard as detected in this study. So, the necessity to develop good agronomic practices such as plant nutrition and crop management appears as important as CBD control in the study area to increase the productivity of coffee. We further recommend conducting a correct estimation of the various causes of berry loss in coffee production in a given area to recommend appropriate and sustainable development strategies aiming at increasing coffee yield.

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