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Bacillus thuringiensis Var. Israelensis (Bti)-based Malaria Vector Control in Rwanda

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Editorial

The influence of long-lasting insecticide-treated nets (LLIN) and indoor residual spraying (IRS) in the worldwide fight against malaria prompted some malaria-endemic nations, like Rwanda, to establish an ambitious target of malaria eradication. At the same time, the existence of residual malaria transmission and local immigration of infected persons pose hurdles to the ultimate objective of malaria eradication in highly endemic locations. Because residual malaria transmission might occur from changes in the behaviour of malaria vectors, malaria removal may be impossible without further and novel treatments.

Several investigations have shown that mosquitos have evolved the capacity to avoid contact with insecticide-treated surfaces. Other instances of behavioural shift include early biting when people are not yet covered by bed nets and tendencies of outdoor biting and resting of malaria vectors that were formerly active inside households. Other malaria vector species have acquired the habit of biting household animals to avoid contact with pesticides. Residual transmission can also be caused by a shift in vector species composition, in which secondary vectors gain high transmission ability and replace prime vectors, owing to ecological and climatic changes [1].

The current study's express goal was to compare the impact of Bti administered through an intervention programme organised and implemented by the rice farming community to an intervention programme managed and overseen by an expert project team. The Bti intervention experiment lasted six months and involved one cycle of rice growing. The local community saw these as insufficient for habitat alteration efforts typically done by the local population. A natural drop in larval populations was found in the control during the trial, which may be explained by the fact that rice growth during the study restricts adult mosquito oviposition on accessible surface water [2].

As a result, we investigated whether the decline over time was greater in the ES and CB arms than in the control arm of the trial. The impact of Bti on Anopheles larvae was much greater in the expert-supervised arm of the trial (estimated at 49 percent decrease each round) than in the community-based (28 percent reduction per round) and control arms (22 percent reduction per round). This shows that careful implementation of larval source management by well-trained experts outperformed implementation by rice-farming groups. The efficiency of a larviciding programme appears to be lowered when it is administered by communities themselves. This decrease might be due to a variety of factors, including less thorough application due to time restrictions and other issues associated with incorporating into everyday rice-farming procedures.

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Several of these issues were noted by Bti sprayer operators in interviews conducted in tandem with the current study. The primary challenges were the development of pits for watering vegetable crops at the bottom of the hills around the rice fields, as well as the new pools and puddles caused by rainfall. An upstream water dam built for rainwater storage and rice field irrigation was also not cleaned since it was inaccessible to operators using simple knapsack sprayers and required a motorised knapsack to assure a large swath of spray [3].

The patterns of mosquito populations reported in our study appear to be typical of populations from irrigated rice fields. Malaria vector growth was greatest in the first six weeks following rice transplanting, then declined as plant height grew and malaria vectors were essentially non-existent towards rice harvest. Due to incorrect drainage during and after rice harvesting, a gambiae s .l. re-established in tiny pools. Mutero noticed a similar pattern in the Mwea rice scheme in Kenya, where the peak larval density was reported three weeks after rice seedling transplanting and thereafter the larval population declined substantially with rice development until the harvesting season.

The effect of Bti on mosquito aquatic stages seen in this study is consistent with findings from other studies done in urban and rural regions throughout Africa. Larviciding resulted in a 96 percent reduction in anopheline larvae after one year of intervention in metropolitan Dar es Salaam, Tanzania, while having a moderate impact on malaria transmission. According to the study, limiting the impact of larviciding to Anopheles may result in a lack of community support since the population does not see a direct, beneficial influence from a reduction in the severity of human bite by Culex mosquitoes.

In urban environments, the effect of larviciding should thus be augmented by environmental management measures and executed by the community itself by reducing household mosquito breeding areas as well. Aside from the spatial range of mosquito breeding sites being vital to Bti performance, the time of the application is also critical. Larviciding with Bti in the rural highlands of western Kenya resulted in a reduction of more than 90% in larval mosquito stages and more than 80% in adult mosquitoes. The impact was reduced during the rainy season, suggesting that larviciding may be more beneficial for malaria control during the dry season and at the start of the rainy season. During this time, mosquito breeding sites are well-defined and enclosed.

In contrast, the impact of larviciding on larval density was found to be mild in flooded riverine environments in the Gambia, with no significant influence on malaria transmission. The larvicide proved ineffective when applied with basic spraying equipment in complex ecosystems that are unstable over time and difficult to access on foot [4,5].

Conclusion

Bti spraying by rice-farming communities themselves inhibited the establishment of malaria vectors from irrigated rice fields and other surrounding ecosystems. Although the impact on the larval stages was less severe in the community-based research arm compared to the expert-supervised arm, pupal production was totally blocked in both arms. Together with the desire to contribute monetarily to the LSM programme with Bti and the high perceived safety and acceptability of the product, our data demonstrates that, in a context with limited resources, communities should become more involved in malaria control activities.

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Conflict of Interest

No potential conflict of interest was reported by the authors.

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