Application of GIS for Mapping the Spatial Distribution of *Ganoderma* Stem Rot in Oil Palm Plantations

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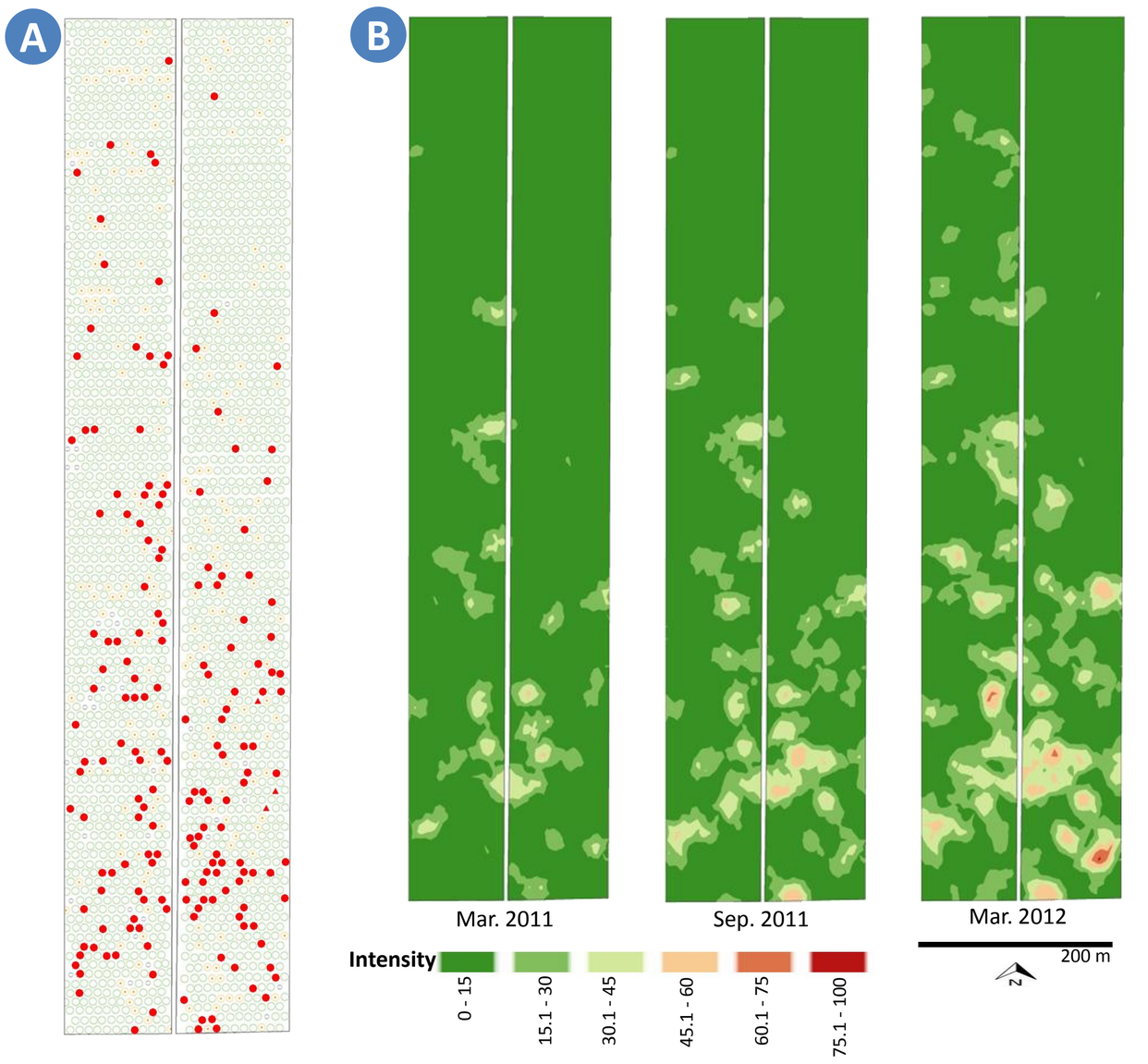
INTRODUCTION

Background: Oil palm is the world most important vegetable oil crop, mainly cultivated throughout Southeast Asia[1]. The major threat to the sustainability of oil palm are *Ganoderma* species, causing stem rot[2,3]. The outbreak of a disease or pathogen could be monitored using sophisticated tools, such as Geographical Information System (GIS)[4,5]. **Justifications:** The application of GIS may provide useful information of the disease such as its spatial distribution and progression. It is important to understand the epidemiology of the *Ganoderma* stem rot in oil palm plantation for better control strategies. **Objective:** Demonstrate the use of GIS in small scale to generate a spatial distribution map of *Ganoderma* stem rot in an oil palm plantation.

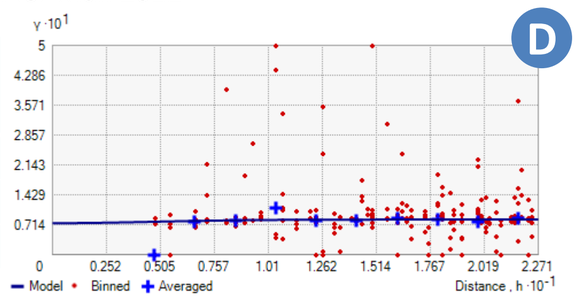


A, Raw data of the spatial distribution of *Ganoderma*; B, GIS maps. Kriged data shows hotspot patterns of the spatial distribution of *Ganoderma*; C, Summary of semivariogram; D, Semivariogram model for Mar. 2012

C

Period	Nugget (C_0)	Standard variance (C)	$C_0/(C_0+C)$ (%)	Range (m)
Mar. 2011	0.012	0.031	27.90	11.66
Sep. 2011	0.010	0.055	15.38	11.66
Mar. 2012	0.075	0.009	89.28	11.66

D



MATERIALS & METHODS

Study site: The study was conducted in a 16 hectares (200 x 800 m) experimental plot of oil palm plantation. **Data collection:** Each oil palms within the study plot were observed for symptoms and signs of *Ganoderma* stem rot[3,6], and located based on the field planting row and column. The oil palms were coded as either "0" for absence of *Ganoderma* (non-infected palm) or "1" for presence of *Ganoderma* (infected palm)[4]. The number of infected oil palms due to *Ganoderma* throughout the study period also recorded. Data were collected from 2011 to 2012 at six months intervals. **Data analysis:** The data were analyzed (interpolated) based on ordinary kriging fitted to semivariogram using ArcMap of ArcGIS 10 program[4,7].

RESULTS & DISCUSSION

The initial occurrence of *Ganoderma* stem rot in oil palm was 4.53%, increased to 6.93%, and reached 9.8% at the end of the census period (within 1 year). The percentages of occurrence provide information on the seriousness of the disease, but unable to show the location or area of occurrence within the study plot. Hence, the spatial distribution may provide more useful information compared to the quantitative distribution. Interpolation (kriging) of the distribution of *Ganoderma* (A) based on a semivariogram (D) generated hotspot pattern or GIS map of *Ganoderma* (B). The semivariogram models provide information about the spatial structure as well as the spatial attributes for the data interpolation. The models can be described by 3 parameters, namely, i) nugget, the measure of variance; ii) sill, the total vertical scale of variogram and equals to the sample variance[8]; and iii) range, the distance or diameter of influence where two samples are related[9]. The semivariogram models in this study were summarized (C). *Ganoderma* occupied at lower range value indicated that they were clustered closely and influenced the zone at closer distance. Higher intensity indicates that there were higher occurrence of *Ganoderma* in a particular area, and vice versa. Most of the *Ganoderma* were accumulated at the Southern as compared at the Northern part of the study plot. Moreover, there were changes in the spatial pattern throughout the year which indicate rapid spread of *Ganoderma* (B). The spatial pattern generated using a GIS tool as in this study may provide useful information as an aid in the design of epidemiological studies, development of more accurate sampling programmes, design and analyze experiments more efficiently, and monitoring programmes. Although this study was based on the small size of experimental plot, the technique could be adopted to larger scale.

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