Effect of haze on fruit development, pigmentation and productivity of Passiflora quadrangularis L. (Giant Granadilla Passion Fruit)

ABSTRACT

The world today faces air pollution as a major environmental problem, as industrialisation and anthropogenic activity are growing rapidly. Agricultural fires in Indonesia and Borneo, along with forest and peatland fires, are responsible for transboundary haze that contributes to environmental degradation in Malaysia (Aziz et al., 2018). Haze occurrence in Malaysia has become a common feature over the last two decades. The most extreme haze phenomena were observed in April 1983, August 1990, June 1991, August 1994, and March 1998 (Jamal et al., 2014). Kuching's API reading in September 1997, spiked to 893 was the highest ever recorded in Malaysia (Ahmad et al., 2006). Most of these haze episodes occurred in conjunction with a period of prolonged drought associated with the El-Nino phenomenon. Haze events are projected to increase as forest and peat fields burning increases due to global warming and prolonged drought worsen (Hawa, 2008). Haze is generally considered to be a product of high concentrations of fine particulate matter circulating in the atmosphere. As the numbers of these particles increase, their cumulative effect causes lower light intensity on Earth and results in reduced visibility (Philip, 2001). Haze development interrupts the natural air circulation, which decreases the dispersion and dilution of suspended contaminants and particles. Haze is often caused by an excessive amount of pollutants, i.e., particulate matter, sulphur dioxide (SO2), carbon monoxide (CO), nitrogen dioxide (NO2) and ozone (O3). Increased aerosol loadings in the atmosphere are aided by burned biomass. Greenwald et al. (2006) showed that atmospheric haze resulting from distant forest fires reduced solar radiation at almost all spectra. About 73-92% of overall light extinction comes from organic carbon and sulfate particles trapped in haze (Yanhong et al., 1996). The field data collected in the Yangtze Delta region of China shows that aerosols reduce solar radiation by about 30% on clear days (Xu et al., 2003). Studies have shown that haze has major effects on various ecosystems as its impact on solar radiation, temperature, and relative humidity resulting in reduced plant photosynthetic activity (Yanhong et al., 1996; Davies and Unam, 1999; Aziz et al., 2018). The photosynthetically active radiation (PAR), a solar radiation utilised by plants and ambient temperature, was reduced by the haze, which indicates a reduction in photosynthesis rate and stomatal conductance. Based on the experimental measurement of the light-CO2 relationship, Fan et al. (1990) reported an increase in cloudiness might decrease net CO2 uptake by the plants. Studies by Aziz et al. (2018) on the yield of Malaysian rice varieties during the haze event in March 2014 showed a major reduction in the net photosynthetic rate and stomatal conductivity due to the reduction of PAR solar radiation. The PAR level at which a plant is exposed is related positively to the photosynthetic and has a significant effect on plant development and growth. Lately, the occurrence of haze over the country has been a great concern. Understanding the plant behaviours and responses is very important to explain their physiological patterns and tolerance when exposed to haze conditions. Therefore, this study was carried out to determine the effects of haze on the fruit

development and productivity of Passiflora quadrangularis during the haze event in July to September 2019 at Bintulu due to forest fires in Indonesia and Borneo.