The Phytotoxicity Effect of Fungicide-Zinc/Aluminium-Layered Double Hydroxide Nanocomposite on Germinated Palm Oil Seeds

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Abstract: Fungicides namely hexaconazole (HC) and dazomet (D) were successfully intercalated separately into the zinc/aluminium-layered double hydroxide (ZALDH) interlayers via the ion exchanged method. The resulting nanocomposites, hexaconazole-ZALDH (HZALDH), dazomet-ZALDH (DZALDH) and their commercially available counterparts; HC and D were used to study their effects on the oil palm seedlings growth. The phytotoxicity results showed that both HZALDH and DZALDH treatments gave positive effects on all the parameters tested. Most of the treatments gave almost similar seedling height of 50 % compared to the control. The HC treatment resulted in the lowest value in all the parameters used in this study, showing that the growth of the seedlings under this treatment was significantly inhibited.

***Keywords*:** Layered double hydroxide, Hexaconazole, Dazomet, Palm oil, Nanocomposites

INTRODUCTION

Basal stem rot or also called BSR is a major threat to the palm oil industry. This disease not only infected the palm oil at older stage which contribute to yellowing and wilting leaves, but the symptoms also has been found in the younger plants [1]. The biocompatibility properties of LDHs has made it an advantage as a carrier in agriculture as the minerals stored in the nanolayer such as Zn^{2+}, Mg^{2+} and Al^{3+} are also helpful in improving the fertility of the land and plants. Thus, our attention is focusing on the synthesis of nanoagrochemicals which believed to be useful in helping the growth of the seedling while at the same time treating the BSR disease in oil palm.

MATERIALS AND METHOD

Zinc and aluminium nitrate hexahydrate were purchased from Sigma Aldrich. Hexaconazole (95 %) and dazomet (98 %) was obtained from Changzhou, China. About 0.5 g of preprepared Zn/Al-NO_3-LDH was added into 250 mL, aqueous solution containing approximately 150 mL 0.2 M fungicide micelle. The suspension was kept at 75 ºC for 72 h under vigorous stirring. The sample was then centrifuged and washed using deionized water and acetone, then dried in an oven at constant temperature of 70 ºC for about 72 h. The obtained fungicide-LDH was denoted as HZALDH and DZALDH.

RESULTS AND DISCUSSION

The histogram below shows that the oil palm seedlings height seedlings after they were subjected to eight different treatments for the duration of 16 weeks. The treatment with DZALDH (T8) has the highest height with 27.92 cm, followed by the control, ZALDH and HZALDH with 26.94, 26.21 and 17.78 cm, respectively. The HZALDH was about 4 times better than hexaconazole-based commercially available fungicide (HC) treatment, which has the lowest height with only 4.64 cm, showing that the growth of oil palm was almost retarded under this treatment.

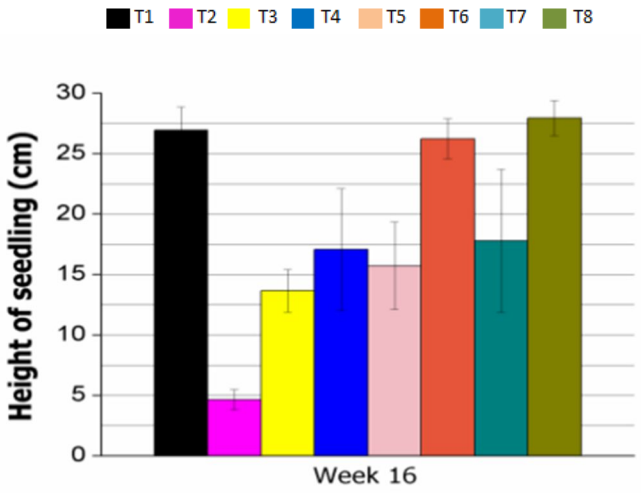

Fig. 1. The effect of various treatments on seedling height (A) and dry weight (B) of oil palm seeds at 16 weeks ; T1 (control) = germinated seeds with tap water, T2 = germinated seed with hexaconazole-based commercially available fungicide (HC); T3 = germinated seed treated with hexaconazole, T4 = germinated seed treated with dazomet, T5 = germinated seed treated with dazomet-based commercially available fungicide (DC), T6 = germinated seed treated with zinc/aluminium-LDH (ZALDH); T7 = germinated seed treated with hexaconazole-based ZALDH nanodelivery system (HZALDH) and T8 = germinated seed treated with dazomet-based ZALDH nanodelivery system (DZALDH)

CONCLUSIONS

The phytotoxicity studies on oil palm seedlings had indicated that both HZALDH and DZALDH were significantly better compared to the commercially available counterparts in term of reducing the toxicity effect of the direct fungicide application. This indicates that the nanocomposites could minimise the toxicity to non-target organism and less burden to the environment.

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REFERENCES

[1] Sanderson, FR. *Mycopathologia* 2005, **159**, 139-141.