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Full Length Research Paper

Growth of theobroma cacao seedlings in the presence of *Digitaria Insularis* weeds

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An experiment to evaluate the growth of *Theobroma cacao L.* seedlings in the presence of *Digitaria insularis* (L.) Mez ex Ekman was conducted at the Cocoa Research Institute of Ghana in 2008. Hybrid cocoa and *D. insularis* seeds were sown in soil-filled polythene bags measuring 25 cm x 37.5 cm. One cocoa seedling and 0, 1, 2, 3, or 4 *D. Insularis* seedlings (equivalent to 0, 20, 40, 60 or 80 seedlings m^{-2}) were maintained in each polythene bag 3 weeks after sowing. The *D. Insularis* seedlings were either slashed at 5 cm above the soil level at intervals of 6 or 10 weeks or not slashed during the entire period of the trial. The experiment was laid out as 5 x 3 factorial with 6 replicates. The growth of the cocoa seedlings was significantly reduced (P≤ 0.05) in the presence of *D. Insularis* seedlings at 23 weeks after sowing. Stomatal conductance, rates of transpiration and photosynthesis were lower in cocoa grown without *D. insularis* than those grown with *D. insularis.* Leaving *D. insularis* unslashed or slashing at 10 weeks intervals, adversely affected the growth of the cocoa seedlings. Slashing *D. insularis* at 6 weeks intervals could not completely eliminate the competitive effects of the weed on the cocoa seedlings, suggesting that clean weeding close to the soil level is important in ensuring good growth of young cocoa among *D. insularis* weeds.

Keywords: Theobroma Cacoa seedlings, *Digitaria Insularis* weeds.

INTRODUCTION

Digitaria insularis (L.) Mez ex Ekman, also known as sour grass is one of several species in the genus *Digitaria,* ranked as the eleventh most serious weed in the world (Holm et al 1977). In Ghana, *Digitaria insularis* is commonly found on lands cultivated with food and industrial crops including young cocoa, roadsides as well as wastelands. It was officially recorded as a weed in Ghana in 1976 (Anon, 1976) but has rapidly spread throughout the vegetation zones of Ghana. Preliminary studies on the growth and phenology of *Digitaria insularis* at the Cocoa Research Institute of Ghana (Beeko and Oppong, 2006, In Press) showed that it had the potential of becoming a noxious weed. It is generally difficult to control after its first flowering (Machado *et al*. 2006) suggesting that cost of managing the weed in plantations and arable crops could be high. Reports of resistance by biotypes of *D. Insularis* to glyphosate (Salas, 2006) could further complicate measures to contain its spread and control. In

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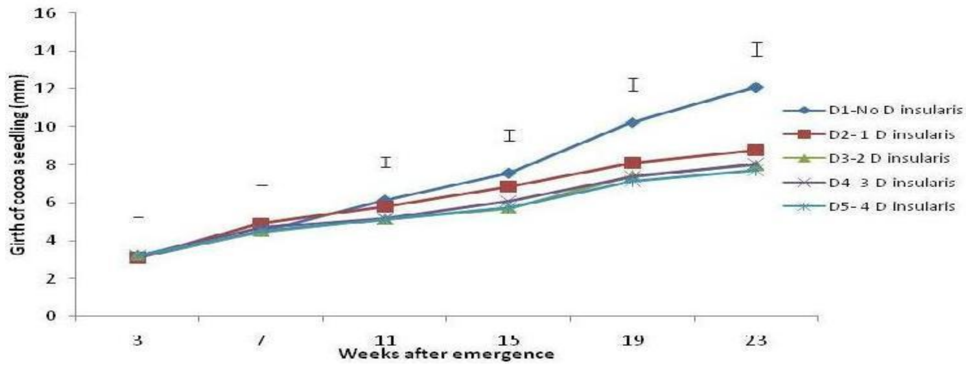

Figure 1. Effect of density of *D insularis* on the girth of cocoa seedlings 23 weeks after emergence

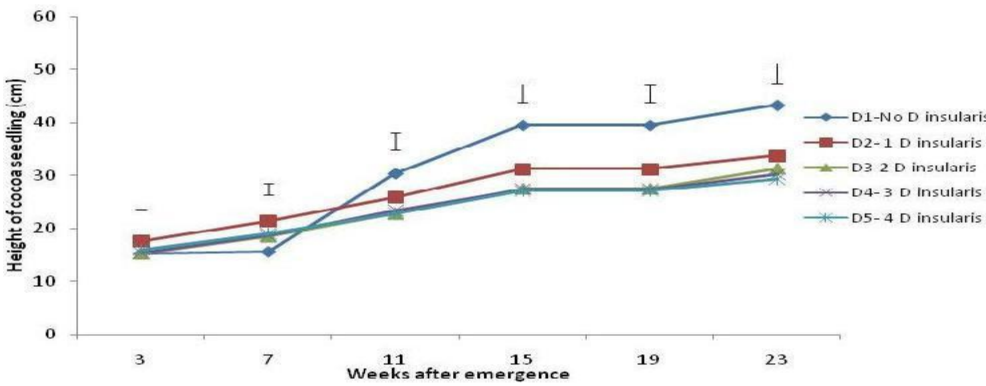

Figure 2. Effect of density of *D. insularis* on the height of cocoa seedlings 23 weeks after emergence

Ghana, *D. insularis* is one of several weed species which quickly colonise secondary bushes cleared for the establishment of cocoa. This study was therefore aimed at evaluating the performance of young cocoa seedlings in the presence of *D. Insularis* weeds.

MATERIALS AND METHODS

Two fresh hybrid cocoa seeds and ten *D. insularis* seeds were sown in polythene bags measuring 25 cm x 37.5 cm filled with top soil. The seedlings were thinned three weeks after sowing to achieve the following treatments:

D1 - Cocoa seedling alone
D2 - Cocoa seedling + 1 *D. insularis* seedling/bag (equivalent to 20 seedlings m^{-2})
D3 - Cocoa seedling + 2 *D.insularis* seedlings/bag(equivalent to 40 seedlings m^{-2})
D4 - Cocoa seedling + 3 *D.insularis* seedlings/bag(equivalent to 60 seedlings m^{-2})
D5 - Cocoa seedling + 4 *D.insularis* seedlings/bag (equivalent to 80 seedlings m^{-2})

Slashing was superimposed on the density treatments as follows:

S1 - No slashing
S2 - Slashing at every 6 weeks
S3 - Slashing at every 10 weeks

The experimental design was RCBD, laid out as 5 x 3 factorial with 6 replicates. Other weeds were controlled by hand picking as and when necessary. Slashing of *Digitaria insularis* was done using a pair of scissors at 5cm above ground level. Girth and height of the cocoa seedlings were determined at monthly intervals. Root volume, dry weights of roots, leaves and stem, stomatal conductance, photosynthetic and transpiration rates of the cocoa seedlings were determined at 23 weeks after sowing.

RESULTS AND DISCUSSION

The stress imposed by *D. insularis* on the young cocoa seedlings was clearly evident from the 7^{th} week through the 23^{rd} week after sowing as shown by the reductions in girth and height as compared to the treatments without the weed (Figures. 1 and 2). Significantly higher ($P < 0.05$) root

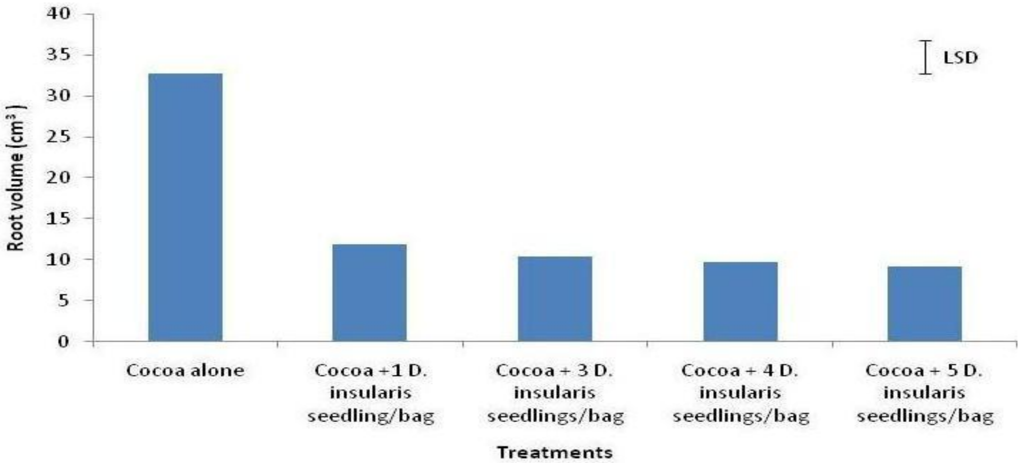

Figure 3. Effect of density of *D. insularis* on the root volume of cocoa seedlings 23 weeks after emergence

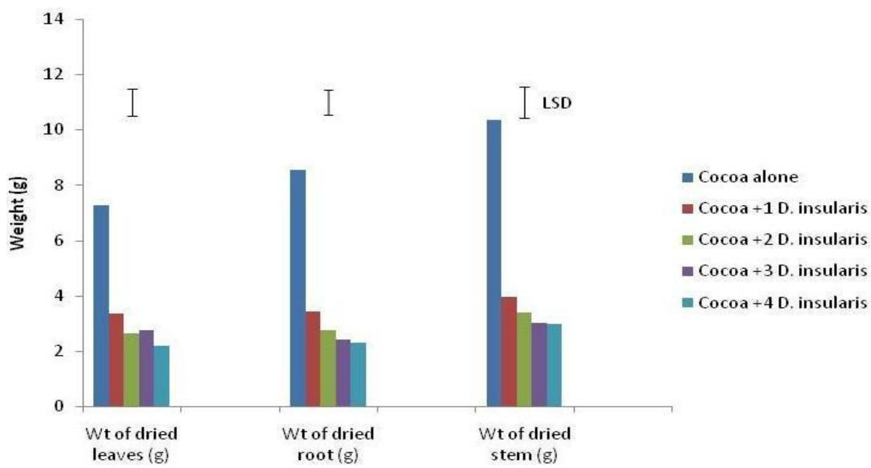

Figure 4. Effect of density of *D. insularis* on the weight of dried leaves, root and stem of cocoa seedlings 23 weeks after emergence

volume, dry weights of leaves, roots, and stem were recorded at 23 weeks after sowing in the control treatment than those with the different densities of the weed (Figures. 3 and 4). The results indicated that even at low density levels, *D.insularis* could still adversely affect the growth and development of young cocoa seedlings. The stress imposed on the cocoa seedlings by the weed resulted in higher stomatal conductance, photosynthetic and transpiration rates as compared to the control but the differences were not significant (Figures. 5, 6, 7).

Slashing of *D. insularis* at 6-weekly intervals significantly (P < 0.05) enhanced cocoa seedling growth at 23 weeks after sowing as compared to the treatments where *D. Insularis* seedlings were slashed at 10 weeks intervals or not slashed for the entire duration of the experiment (Figures. 8, 9, 10). However, as compared to the control treatment where cocoa was grown without *D. insularis*, slashing at 6-weekly intervals was inadequate to completely remove the competitive effects of the weeds on the cocoa seedlings. This is because *D insularis*, like most grasses, regenerates from the basal rhizomes situated just above the soil surface (Baker and Terry, 1991) hence slashing only reduces competition for light but not for soil moisture and nutrients for rapid regeneration of the shoots.

Considering the fact that *D insularis* is a prolific seed producer with high germination rate (Beeko and Oppong, 2006 In Press), it is important that they are controlled during the early stages of their growth before flowering since it would be difficult to manage after flowering (Machado *et al*. 2006). Clean weeding close to the ground or using a systemic selective herbicide could be very important in reducing the competitive effects of *D insularis* in young cocoa seedlings.

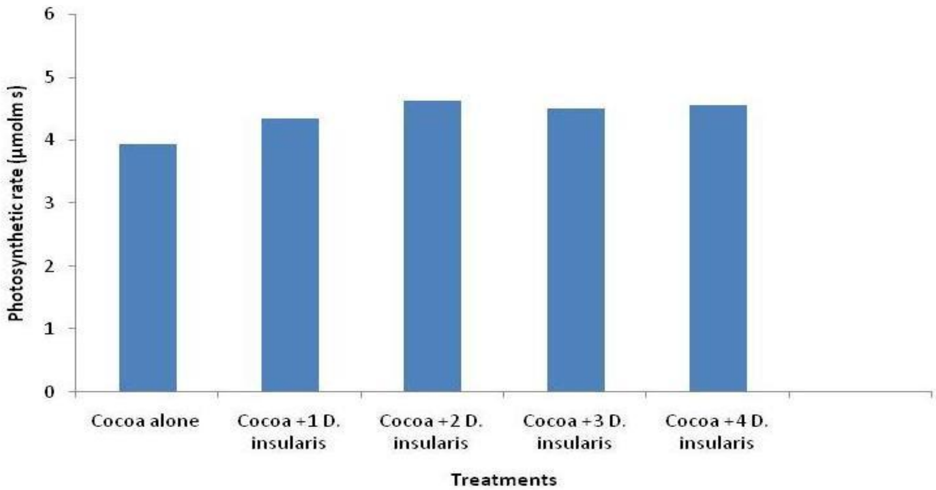

Figure 5. Effect of density of *D. insularis* on the photosynthetic rate of cocoa seedlings 23 weeks after emergence

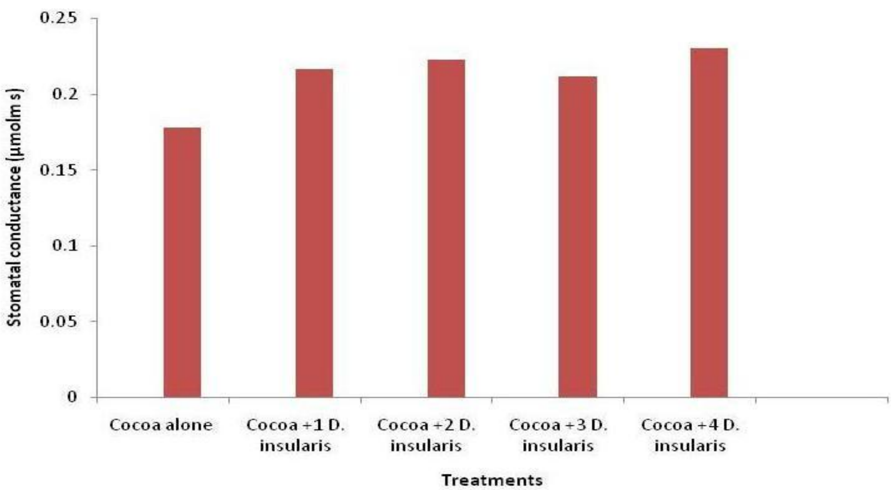

Figure 6. Effect of density of *D. insularis* on the Stomatal conductance of cocoa seedlings 23 weeks after emergence

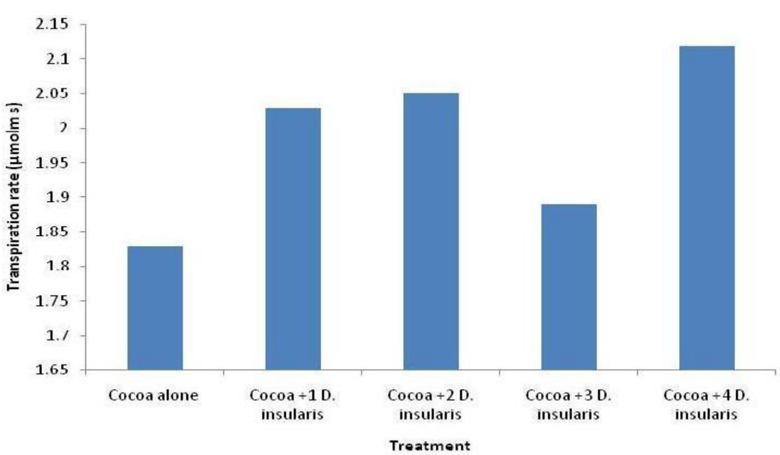

Figure 7. Effect of Density of *D. insularis* on the transpiration of cocoa seedlings 23 weeks after emergence

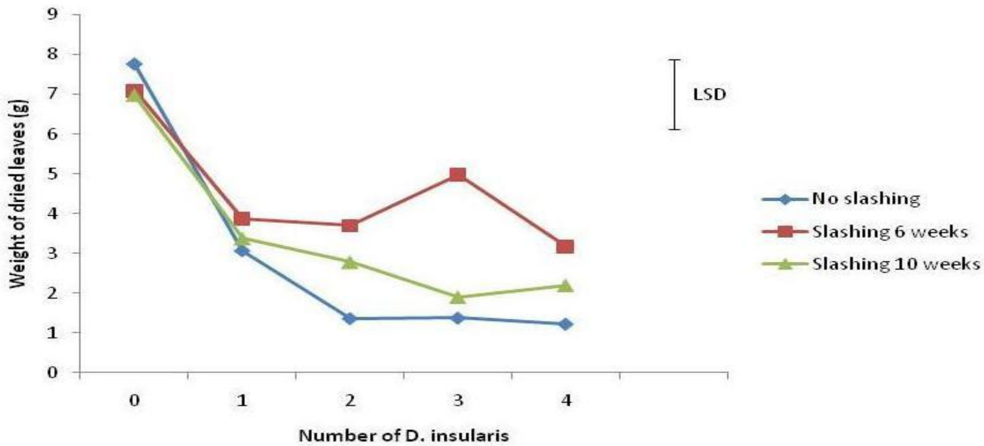

Figure 8 Effect of density and slashing of D. *insularis* on the dry weight of leaves of cocoa seedlings 23 weeks after emergence.

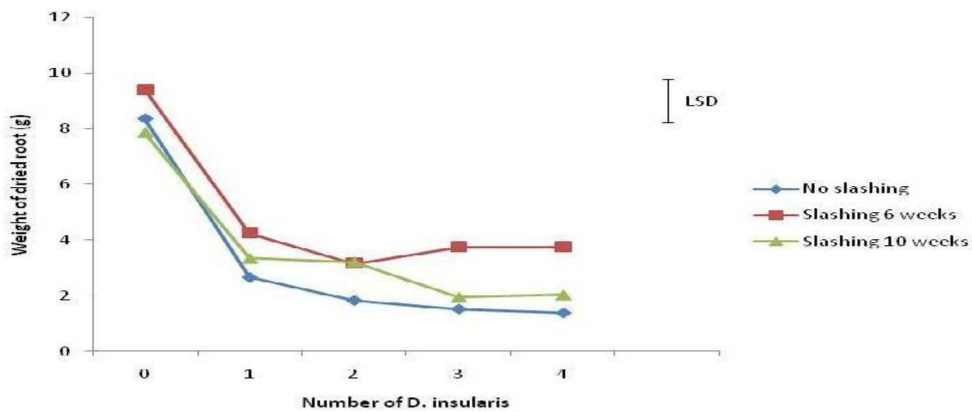

Figure 9 Effect of density and slashing of D. *insularis* on the dry weight of roots of cocoa seedlings 23 weeks after emergence.

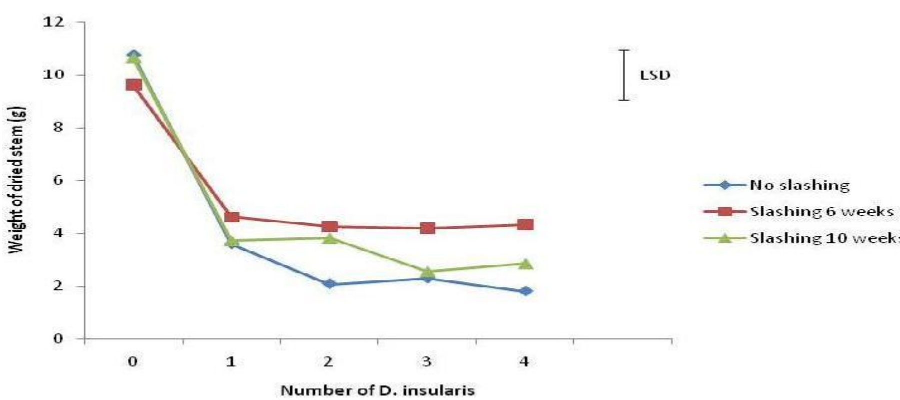

Figure10 Effect of density and slashing of D. *insularis* on the dry weight of stems of cocoa seedlings 23 weeks after emergence

CONCLUSION

D. insularis, even at low densities adversely affected the growth of young cocoa seedlings. Although slashing at 6 weeks intervals enhanced the growth of the seedlings, it could not completely eliminate the competitive effects of the weeds on the cocoa seedlings. Clean weeding close to the soil level or applying a systemic selective herbicide could reduce the stress imposed by *D insularis* in young cocoa seedlings to ensure good growth.

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