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Growth and Biomass Accumulation of *Vigna unguiculata* L. and *Zea mays* L. as Affected by Different Concentrations of Aqueous Extracts of *Tithonia rotundifolia* (Mill.) S.F.Blake

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Abstract:- *Tithonia rotundifolia* which belong to the family Asteraceae has become an invasive weed in Nigeria as it is displacing traditional weedy species. The allelopathic effects of the extracts prepared from this weed on the growth and biomass accumulation of *Vigna unguiculata* and *Zea mays* were investigated. These plants were subjected to different concentrations (25%, 50%, 75% and 100%) of the extract while water served as control. The growth parameters were determined according to standard methods. The data obtained were subjected to Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT) to determine significant (P< 0.05) effects. Result showed that the extracts of the donor plant inhibited the shoot height, root length, leaf area, fresh and dry weights of the test crops (*Vigna unguiculata* and *Zea mays*). The phytotoxic effect of the extract was dose dependent. There was inhibition of growth and biomass of the receptor plants which was an indication that the extracts contain some allelochemicals which were responsible for the phytotoxic inhibition observed in this study. Therefore, these plants should be grown on field free of *T. rotundifolia.*

***Keywords:-** Allelopathic, Allelochemicals, Phytotoxic, Tithonia Rotundifolia, Extracts,*

I. INTRODUCTION

Allelopathy has been defined by many authors as the production and release of allelochemicals into the soil which affect the growth of plants in the environment (Rice, 1984; Cheema *et al*., 2013; Inderjit, and Callaway, 2003; Baziar *et al*., 2014). These allelochemicals can make their way to soil from parent plants via leach out from roots, littering and decomposition of fallen parts and correspond to allelopathic interactions with other plants; the allelopathic interactions among donor and receiving plants can be growth inhibitory to suppress the competitors or stimulatory to co benefit from the available resources which generally depend on the interacting species, nature and concentration of allelochemicals and the soil biota (Saraf *et al*. 2014; Cheng and Cheng 2015; Fernandez *et al*. 2016; Majeed *et al*. 2017). Several workers have reported the inhibitory effects of aqueous extracts from allelopathic plants on recipient crops (Saeid *et al.* 2010; Gerhard and Christiaan, 2018; Alagesaboopathi, 2011).

Tithonia rotundifolia (Miller) S.F. Blake is a widespread weed species that has colonized roadsides, waste places, fallow land and disturbed open spaces like abandoned construction sites in Nigeria (Adebowale and Olorode, 2005). The weed associates with cultivated crops and becomes the dominant plant where it is present (Tongma *et al.*, 1998). This study investigates the effects of aqueous extracts of *T. rotundifolia* on the growth and biomass of *V. unguiculata and Z. mays* plants.

II. MATERIALS AND METHODS

The shoots of *T. rotundifolia* were extracted in water according to the modified method of Anh and Chung (2000). Plastic pots (25 cm diameter x 22 cm height) with four holes perforated at the bottom for good drainage were filled almost to the brim with top humus soil. Seeds of the test crops were sown in pots filled with top humus soil. At two weeks, seedlings in each pot were thinned down to 10 seedlings per pot. Thereafter, the pots in the control regime were supplied with water daily while the pots belonging to the different treatments were supplied with the appropriate water extracts (FWE) daily in same quantity. The shoot height, root length, leaf area, fresh and dry weights were determined according to standard methods. The data obtained were subjected to (ANOVA) to determine significant (P< 0.05) effects. The means were compared using Duncan Multiple Range Test (DMRT)

III. RESULTS

V. unguiculata in the control had a higher shoot height compared to the FWE plants in the latter weeks of the experiment while that of *Z. mays* in the control was higher throughout the experiment. The shoot height of the *Z. mays* extract treated plants was significantly inhibited at P < 0.05 throughout the duration of the experiment. The shoot height of both test crops increased with decrease in the concentration of the FWE extracts in the latter weeks of the experiment (Fig. 1). The extract treatments applied decreased the root length of both test crops when compared to the control plants throughout the experiment. The root

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length of the FWE plants followed the trend: 25% > 50% >75% > 100% except for the *V. unguiculata* plants where the root length of both the 25% and 50% FWE plants was almost equivalent. The root length of both test crops increased with decrease in concentration of the FWE extracts (Fig.1). The leaf area of the treated plants was significantly lower than that of the control plants. The leaf area of *Z. mays* plants in the FWE regime followed the same trend as observed for root length (Fig.2).

The *Z. mays* plants in the control had a shoot fresh weight that was significantly higher than that of the treated plants throughout the duration of the experiment while in the case of the *V. unguiculata* plants, the shoot fresh weight of the control plants was significantly ($P< 0.05$) higher than that of the treated plants only in the latter weeks of the experiment (Fig.3). The root fresh weight of the control *V. unguiculata* plants was higher than that of the extract treated plants in almost all the weeks of the experiment. The 100% FWE *V. unguiculata*, had root fresh weight that was significantly ($P< 0.05$) lower than that of the plants in the other treatment regimes in most weeks of the experiment (Fig. 3). The shoot dry weight of *V. unguiculata* and *Z. mays* in the control was higher than that of the plants in the treatment regimes in most part of the experiment while the plants in the 100% FWE extracts regimes had shoot dry weight that was the lowest in the latter weeks (Fig.4). The control had the highest root dry weight except for the root dry weight of the control *Z. mays* which was highest on weeks three and six. The 100% FWE plants had the lowest root dry weight throughout the duration of the experiment (Fig. 4)

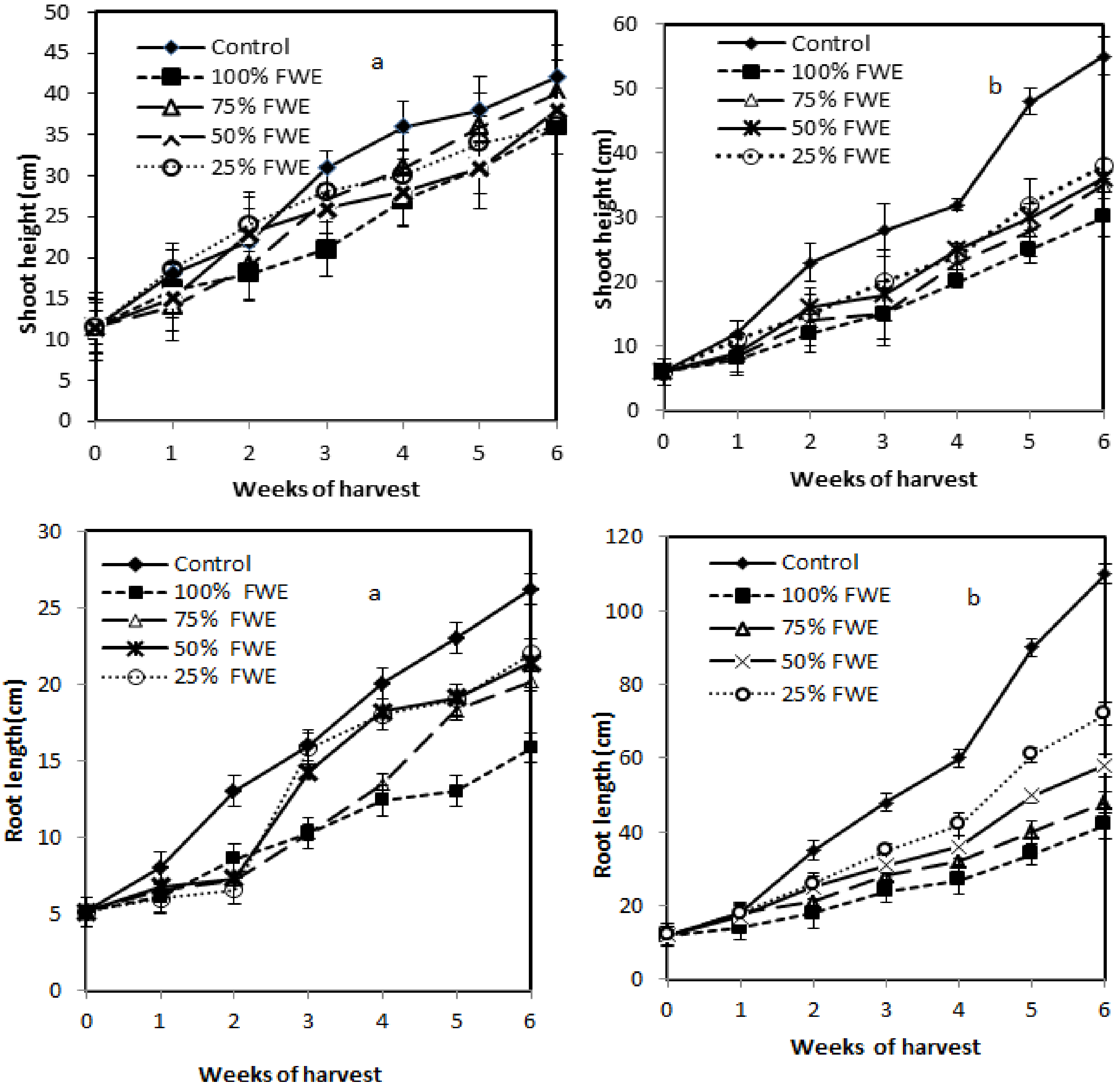

Fig 1:- Shoot height and root length of *V. unguiculata and Z. mays* as affected by the water extracts of *T. rotundifolia*

FWE: fresh shoot water extracts of *T. rotundifolia*
a. *V. unguiculata* b. *Z. mays*

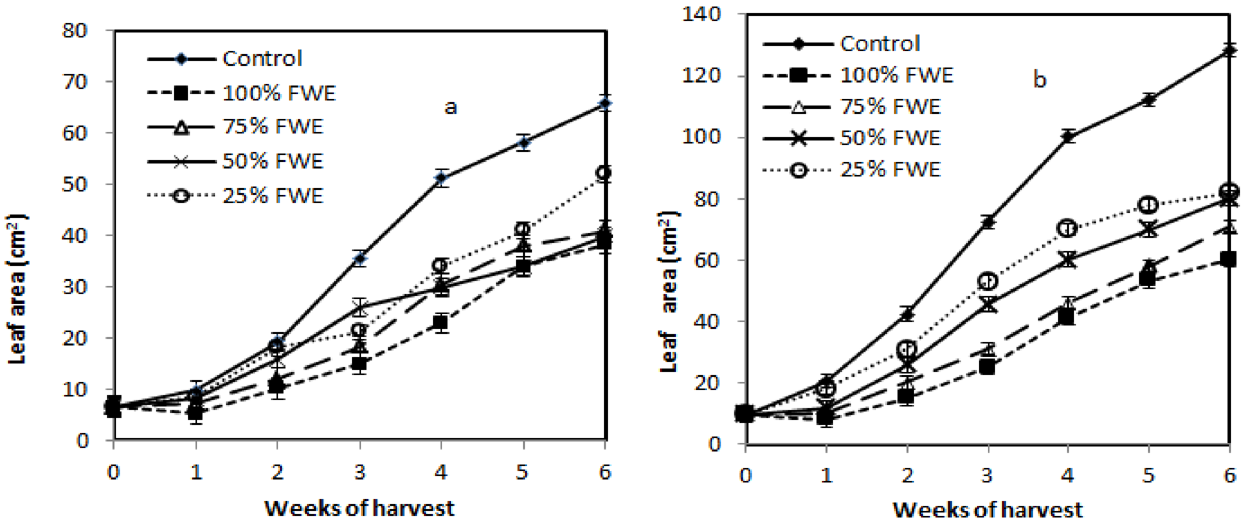

Fig 2:- Effect of water extracts of *T. rotundifolia* on the leaf area of *V. unguiculata and Z. mays*

FWE: fresh shoot water extracts of *T. rotundifolia*
a. *V. unguiculata* b. *Z. mays*

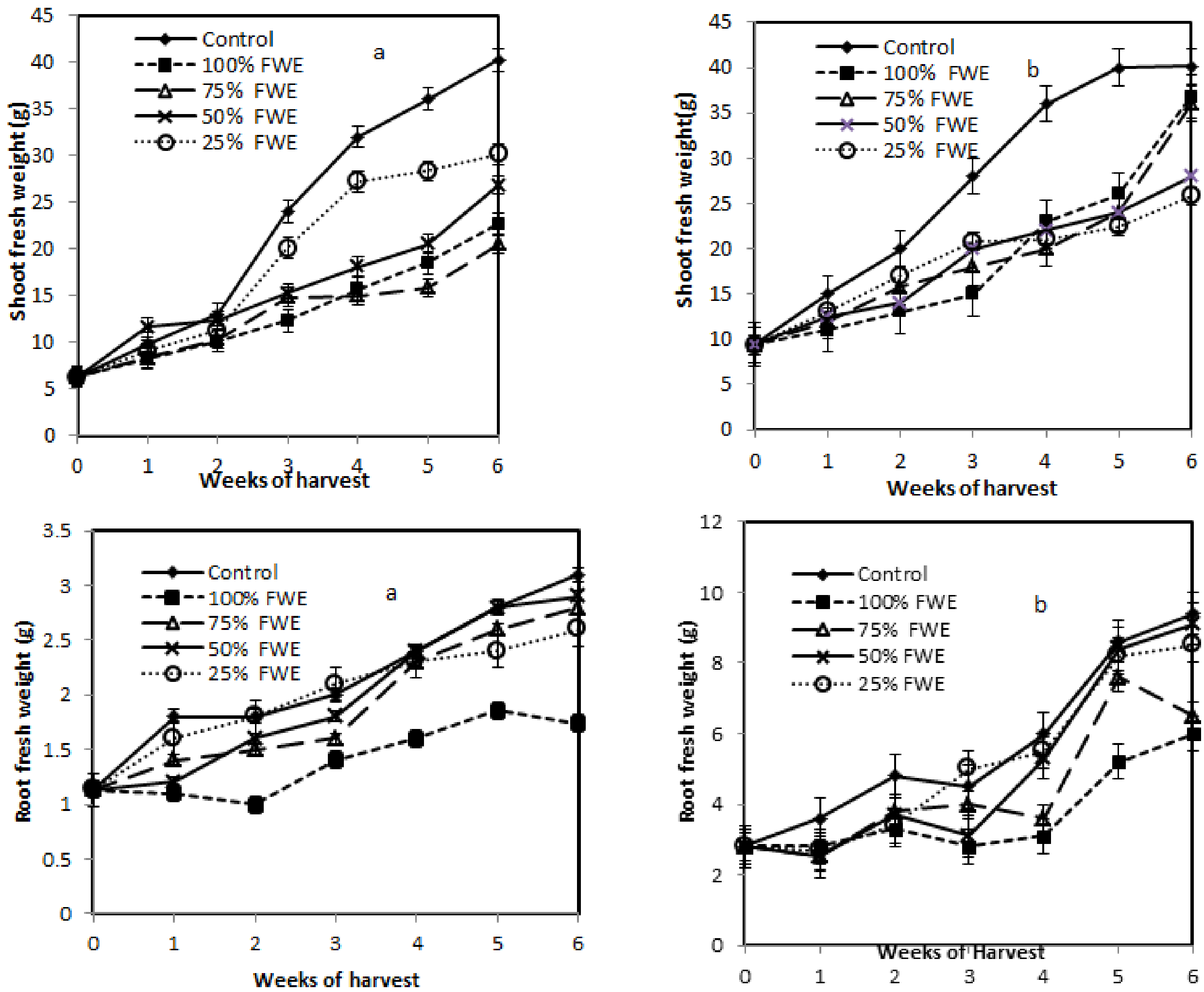

Fig 3:- Variation in the shoot and root fresh weight of *V. unguiculata* and *Z. mays* treated with the water extracts of *T. rotundifolia*

FWE: fresh shoot water extracts of *T. rotundifolia*
a. *V. unguiculata* b. *Z. mays*

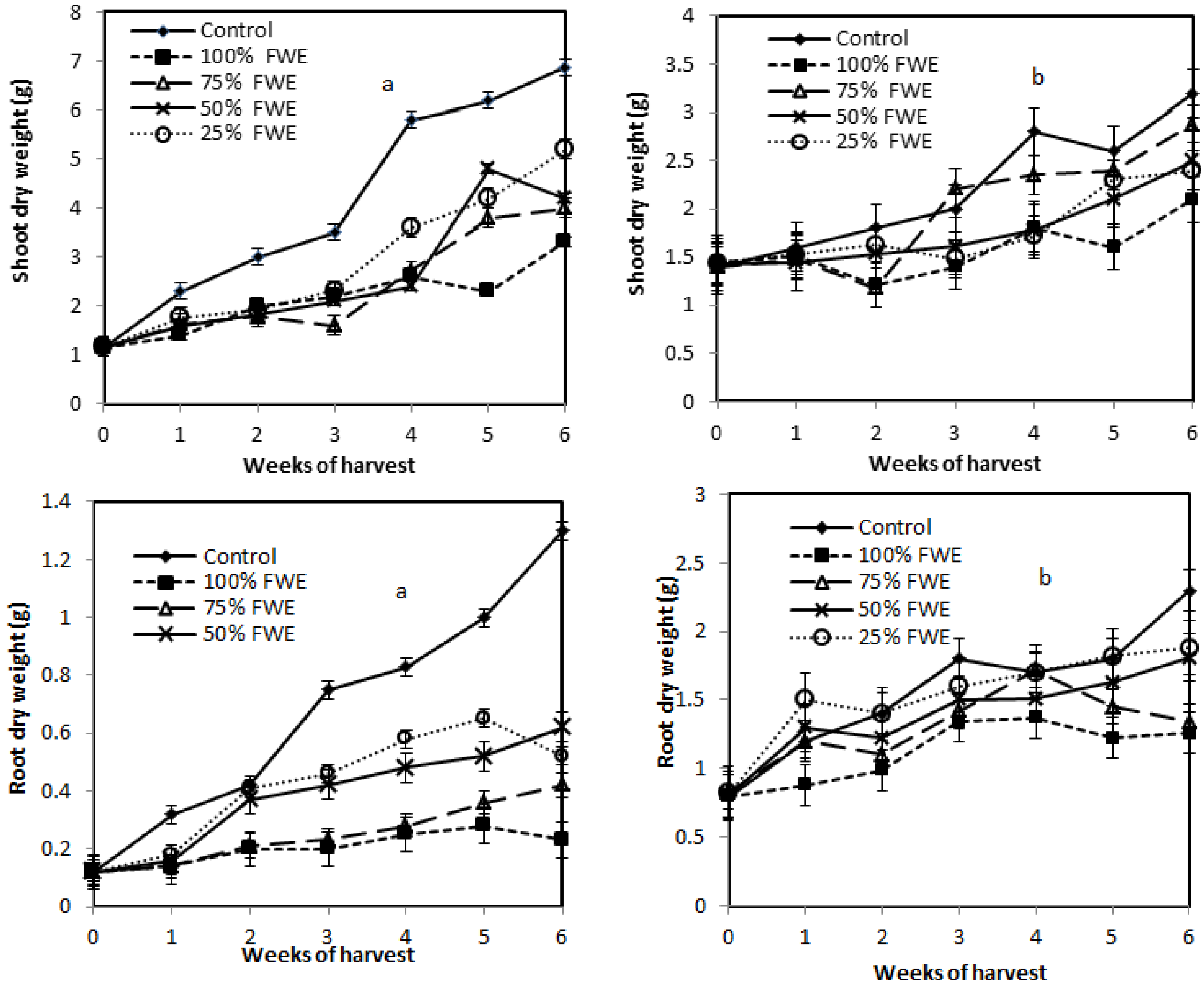

Fig 4:- Variation in the shoot and root dry weight of *V. unguiculata* and *Z. mays* treated with the water extracts of *T. rotundifolia*

FWE: fresh shoot water extracts of *T. rotundifolia*
a. *V. unguiculata* b. *Z. mays*

IV. DISCUSSION

There was an inhibition of the growth and biomass of the receptor plants. This could be due to the allelochemicals in the extracts which affected growth and biomass of the receptor plants. The result corroborates the finding of Abu-Romman *et al.* (2010) who observed that aqueous leaf leachates of *Euphorbia hierosolymitana* reduced the shoot height of wheat (*Triticum durum*). Filemon *et al.* (2013) also reported an inhibitory effect of extracts on shoot length and root length of recipient plants. The growth of the roots was more inhibited than that of the shoots. This result corroborates the earlier findings of El-Amier and Abdullah (2014) who observed that root growth was more sensitive to the plant aqueous extracts when compared to the shoot growth. Muhammad *et al.* (2015) explained that the root growth was more retarded than the shoot growth because the root is the first organ that absorbs the allelochemicals from the environment. Fresh and dry biomass accumulation of the receptor plants was retarded by the treatment with water extracts of *T. rotundifolia*. This finding was consistent with that of Ahn and Chung (2000) and Khan *et al.*, (2008), who observed significant reductions in shoot and root fresh and dry weights of recipient plants by aqueous extract of donor plants. The inhibition of the root length and leaf area by the different concentration of the extracts was extracts dose dependent. This finding was consistent with a number of studies which showed that allelopathic effects of receptor was depend on the concentrations of water extracts of organs from donor plants, different concentration has different effects (Siddiqui *et al.*, 2009; Swapnal and Badruzzaman 2010; Sitthinoi *et al.*, 2017).

V. CONCLUSION

In conclusion, the inhibitory effect of the extracts was dose dependent. The inhibition of growth and biomass of the receptor plants was an indication that the extracts contain some allelochemicals which were responsible for the phytotoxic inhibition observed in this study. Therefore, the receptor plants should be grown on field free of *T. rotundifolia.*

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