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ALLELOPATHIC EFFECT OF AQUEOUS EXTRACTS OF *Tithonia rotundifolia* P. M Blake AND *Murraya koenigii* L. ON THE GROWTH AND BIOCHEMICAL CONSTITUENTS OF *Capsicum annuum* L. AND *Corchorus olitorius* L.

TIJANI MUSA OYEBAMIJI

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APPROVAL

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DEDICATION

This thesis is dedicated to my late father, Alhaji Tijani Oyebamiji who did so much to make me what I am today. May his gentle soul rest in peace.

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ABBREVIATIONS

The following abbreviations were adopted in the investigation of germination, growth parameters, chlorophyll, ascorbic acid accumulation and crude protein content determination

CTR: Control supplied with tap water

MPG: Mean Percentage Germination of the test crops

FSEM: Test crops to which fresh shoot aqueous extract of *M. koenigii* was applied

FSET: Test crops to which fresh shoot aqueous extract of *T. rotundifolia* was applied

LAR: Leaf Area Ratio of the test crops

ABSTRACT

The study was conducted to investigate the allelopathic effects of fresh shoot aqueous extracts of *Murraya koenigii* L. and *Tithonia rotundifolia* P. M. Blake on the growth and biochemical constituents of *Capsicum annuum* L. and *Corchorus olitorius* L. plants.

Germination experiment was carried out by raising the seedlings of the two target crops in Petri-dishes lined with Whatman No 1 filter paper and moistened with 10 ml of different concentrations (50 % and 100 % representing half and full strength) of the aqueous extracts of *M. koenigii* and *T. rotundifolia*. For the growth parameters (shoot height, root length, number of leaves, leaf area, leaf area ratio), yield parameters (fresh shoot and root weight, dry shoot and root weight) and quality parameters (chlorophyll, ascorbic acid and crude protein) analyses, potted plants were separated into the control and two other regimes namely: fresh shoot aqueous extract of *T. rotundifolia* (FSET) and fresh shoot aqueous extract of *M. koenigii* (FSEM). The pots were arranged in a completely randomized design. The control plants were supplied with 600 ml of tap water while the extract-treated plants were supplied with 600 ml of the appropriate aqueous extracts daily. Harvesting started at two weeks and continued thereafter on a weekly basis for six weeks. Chlorophyll accumulation, ascorbic acid, percentage nitrogen and crude protein content were determined using standard methods. The data were analyzed using Analysis of Variance (ANOVA) and Least Significance Difference (LSD $p < 0.05$).

The extracts significantly inhibited the germination of the seeds and the plumule and radicle lengths of both target crops. This effect was extract concentration dependent (100 % > 50 % > Control). The applied extracts of *M. koenigii* plants significantly promoted virtually all the growth parameters such as shoot height, number of leaves, leaf area, leaf area ratio, fresh

shoot weight, fresh root weight, dry shoot weight, dry root weight, chlorophyll a, chlorophyll b, total chlorophyll, ascorbic acid and protein accumulation of the two target crops. The aqueous extract of *T. rotundifolia* enhanced only the shoot height, leaf area, root fresh weight, chlorophyll a, chlorophyll b, total chlorophyll, ascorbic acid and protein accumulation in the shoot of *C. annuum*. The root length was however, significantly inhibited by both aqueous extracts. In the case of the potted plants, the effects of the extracts on the various parameters studied followed the order: FSEM > FSET > CONTROL and was target species dependent.

The results presented in this work showed that FSEM had more pronounced stimulatory effects on the studied parameters than the FSET. It was evident that while the level of the allelochemicals in the extracts of the two donor plants was phytotoxic to and inhibited the germination and growth of the juvenile seedlings in the Petri-dishes, they, however, had a stimulatory effect on the growth of the matured potted plants as well as on the accumulation of the biochemical constituents studied.

CHAPTER ONE

INTRODUCTION

The genus *Tithonia* belongs to the family Asteraceae. There are about 11 species of the genus worldwide out of which two are in Nigeria (Muoghalu and Chuba, 2005). *Tithonia rotundifolia* P. M. Blake and *Tithonia diversifolia* (Hemsl.) A. Gray are invasive annual weeds known to be native to Mexico and Central America (Akobundu and Agyakwa, 1987). According to Ayeni *et al.* (1997), they were initially introduced to improve soil fertility and crop yields in Nigeria. However, the weeds are now observed to grow aggressively along road paths, abandoned farmlands and hedges all over Nigeria (Akobundu and Agyakwa, 1987). *Tithonia* species have been reported to contain some allelochemicals and therefore suggested as being capable of posing a serious threat of phytotoxicity to agricultural crops (Tongma *et al.*, 1998).

Olabode *et al.* (2009) found that *T. diversifolia* contains phytochemical constituents such as alkaloids, flavonoids, tannins and saponins. Recent phytochemical screening by Otusanya and Ilori (2012) revealed that the methanolic and water extracts of *T. rotundifolia* contained glycosides, tannins, flavonoids, saponins, phenols, terpenoids and alkaloids. Ayeni *et al.* (1997) stated that allelochemicals that are toxic may inhibit shoot/root growth, nutrient uptake, or may attack a naturally occurring symbiotic relationship, thereby destroying the plants usable source of nutrients. According to the same authors, the consequent effects may be inhibited or retarded germination rate, reduced radicle/root or plumule/shoot extension, lack of root hairs, swelling or necrosis of root tips, curling of the root axis, increased number of seminal roots, discolouration, reduced dry weights accumulation and lowered reproductive capacity. Imeokpara and Okusanya (1994) observed that most farmers find it difficult to manage the infestation of these weeds in most crop fields particularly in rice and maize fields.

Murraya koenigii L. commonly called 'curry leaf' belongs to the family Rutaceae. It is an aromatic, deciduous shrub which is native to India (Satyavati *et al.*, 1987). The plant is used as a spice for its characteristic flavor and aroma and as a flavouring agent in curries and chutneys (Gopalan *et al.*, 1984). In India, it is used both in conventional and traditional medicine to treat various ailments (Arivoli and Tennyson, 2011). Phytochemical constituents such as alkaloids, volatile oils, xanthoxin and carotenes are present in *M. koenigii* (Chakraborthy, 1970; Bordner *et al.*, 1972). It was recently observed that in areas where *M. koenigii* grows, the growth of other plants was hampered, hence, it was suspected to possess allelopathic attributes.

The two test crops in this study are; *Corchorus olitorius* L. and *Capsicum annuum* L. The genus *Corchorus* is a member of the family Tiliaceae, native to the tropical and sub-tropical regions of the world (Nath, 1976). *C. olitorius* commonly known as wild okra is a tall herbaceous annual vegetable whose nutritious leaves and fruits are widely consumed among rural communities in most parts of Africa (Velempini *et al.*, 2003). In West Africa, it is commonly cultivated and popularly used for soup among people of all classes especially in Nigeria (Oyedele *et al.*, 2006). According to Zakaria *et al.* (2006), wild okra is used in folklore medicine in the treatment of gonorrhea, chronic cystisis, pain, fever and tumour.

The genus *Capsicum*, as presently perceived, include at least 25 species of vegetables, four of which have been domesticated. *Capsicum annuum* L. is the best known domesticated species in the world (Esbaugh, 1993). Navarro *et al.* (2006) stated that *C. annuum* originated from northern Latin America and has become an important agricultural crop, not only because of its economic importance, but also for the nutritional value of its fruits. Howard *et al.* (2000) observed that this vegetable is an excellent source of natural colours and antioxidant compounds. Hence, the intake of these compounds in food is an important health-protecting factor.

According to Bramley (2000), *C. annuum* has been observed to be beneficial for prevention of widespread human diseases, including cancer and cardiovascular diseases. It is also known to contain vitamin C, an important compound of pepper fruits which chelates heavy metal ions (Namiki, 1990), reacts with singlet oxygen and other free radicals and suppresses peroxidation (Bielski *et al.*, 1995; Harris, 1996), thereby reducing the risk of arteriosclerosis, cardiovascular diseases and some forms of cancer.

Therefore, the specific objectives of this study were to;

a) Investigate the effects of fresh shoot aqueous extracts of *M. koenigii* (FSEM) and *T. rotundifolia* (FSET) on the germination and some growth parameters such as the shoot height, number of leaves, leaf area, leaf area ratio and yield parameters such as fresh shoot and root weights, dry shoot and root weights etc. of *C. annuum* and *C. olitorius*, and
b) Investigate the effects of the fresh shoot aqueous extracts of *M. koenigii* and *T. rotundifolia* on the chlorophyll, crude proteins and ascorbic acid accumulation in the shoots and fruits of *C. annuum* and *C. olitorius*

The study is expected firstly, to contribute to the understanding of the importance of allelopathy in weed-crop relations and secondly, to determine the nature of interference of allelochemicals in *M. koenigii* and *T. rotundifolia* on the germination, growth and accumulation of some important chemical metabolites in *C. annuum* and *C. olitorius*.