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Comparative Effects of *Fiscus exasperata* Extract on Growth Parameters and Proximate Contents of Amaranth *Amaranthus hybridus* Lin

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ABSTRACT

The use of plant extracts as insecticidal plants has become widespread as alternative to synthetic insecticides and their alternative use as growth stimulants and nutritional enhancer should be evaluated. Therefore, this experiment was conducted to determine the effects of Fiscus exasperata leaf, and the combination of both extracts on the Amaranthus hybridus growth, proximate and mineral contents in the harvested leaves. The experiment was arranged in randomized complete block design and each treatment was replicated three times. Data were collected on plant height, number of leaves, yield, proximate and mineral contents of the harvested leaves. Data collected were subjected to statistical analysis and means were separated using Ducan's multiple range test. The results showed that plant height, number of leaves and yield obtained from the amaranth plants treated with F. exasperata extracts were comparable with that of Chlorpyrifos. However, harvested leaves from amaranth plants treated with F. exasperata extracts had higher mineral and proximate contents than harvested leaves from plants sprayed with Chlorpyrifos and plant extracts. Meanwhile, F. exasperata leaf improved nutritional contents of the harvested leaf than F. exasperate bark extracts and the treatment combinations performed better than the mixture of F. exasperata leaf and back extract with respect to nutritional contents but none of the plant extract formulations caused negative effects on the plant growth. Therefore, F. exasperata extract can be used a major source of green vegetable plant growth and nutritional enhancer.

INTRODUCTION

Amaranth species belong to the family *Amaranthacea* and includes over 70 species. It's a green vegetable which attracts farmers' interest because of its ethnic crop marketing due to its cultural value (Bosch *et al*., 2009). Amaranth is a very common leafy vegetable in Africa, Asian, Latino and Caribbean culture. According to Robert *et al.*, (2013) there was tremendous demand for the consumption of Amaranth in Africa continent which can be attributed to its important as a valuable source of food, medicine, and income for small scale farmers. Amaranth is easily cultivated, adapt well to the challenging growth environments with lesser disease attack (Shukla *et al.*, 2010). Studies have shown that *amaranthus* contains high level of essential amino acids and mineral elements like calcium, iron, and zinc (Andini *et al.*, 2013; Kwenin *et al.*, 2011). It is a good source of vitamins because it contains about thirteen times higher iron and B-carotene (Vitamin A) which was fifty times better than cabbage (NR, 2006). It also contains several phytochemical compounds such as phenolics and flavonoids (Onyango *et al*., 2012) associated with strong antioxidant activity (Hyeon-Ju *et al*., 2015).

In view of the destructive potential of these common insect pests of cowpea in the study area, their control becomes imperative to obtain a reasonable grain yield. Poor resource farmers in Nigeria rely heavily on imported synthetic insecticides such as Lambda cyhalothrin, dichlorvos etc. due to their higher efficacy on the target insects. However, synthetic crop protection chemicals have been implicated to have caused environmental hazard and pest resistance and resurgence (Luz *et al*., 2009; Ramshwar, 2010). These problems have been a serious concerned to the entomologists and environmentalists in less developed countries. Different alternatives have been tested such as plant resistance, botanical insecticides, and biological control for the management of field insect pests however botanical insecticides have been reported as a suitable alternative to synthetic insecticides due to the cost implication and availability. Botanicals are generally pest specific and are relatively harmless to non-target organisms including man (Isman, 2006). Apart from low toxicity of botanical insecticide, the processing and application of the products are not expensive as synthetic insecticide (Rameshwar, 2010).

Ficus exasperata belongs to *Moraceae* family and is popularly called sandpaper leaf tree because of its rough surface (Oladosu *et al*., 2009). Traditionally, it has been used to cure a lot of ailments, thus studies have validated this claim (Barfo & Ighinuwen, 2009). Several literatures have established *F. exasperata* leaves can be used as anti-ulcer, hypotensive, hypoglycemic, hypolipidemic, anti-inflammatory, anxiolytic, oxytocin inhibiting, anticonvulsant, antinociceptive, antipyretic, anti-microbial, anticandidal, insecticidal and pesticidal activities (Barfo & Ighinuwen, 2009; Woode *et al*., 2009; Adewole *et al*., 2011; Alamu, 2018). In view of this, there is a need to determine the effects of applied insecticides on the yield parameters as well as nutrition contents of the harvested products (Alao *et al.,* 2020).

MATERIALS AND METHODS

The field experiment was conducted in the cropping season of 2020 and 2021 at Ladoke Akintola University of Technology (LAUTECH) Teaching and Research Farm, Ogbomoso, Oyo state. This region is on longitude $4^0$3'E and latitude $10^0$5'N.

Land Preparation and Experimental Design

After selection of the site, ploughing was done to remove roots of existing plants and weeds on the plot, debris was cleared and later harrowed to obtain good tilth suitable for planting. Five (5) plots were demarcated and arranged in randomized complete block design with three (3) replicates. Each plots had three (3) plant rows and 2 g of *A. hybridus* was planted per planting row with two seeds in a hole and spacing of 0.5 m. The size of the plot was 3 m x 3 m with 0.5 m spacing between plots of the block and 1 m x1 m spacing between the replicates.

Preparation of Plant Extract

Bark and leaves of *F. exasperata* were used for this study. These plant parts were air-dried separately for two weeks to avoid photodecomposition of the chemical active compounds of the plants. The dried plant parts were crushed separately with mortar and pestle into the powdered form out of which 800 g were measured out and mixed with the following inert materials: 10 g of black soap and 10 g of salt. This mixture was put into 10 liters capacity containing 3000 ml of water and stirred vigorously with stick, this was allowed to stay overnight. Filtration was done with muslin cloth and filtrates collected were stored in 5 liters plastic kegs separately as a stock solution for further use.

Treatment Application

From the stock solutions, 1000 ml was measured out and 20% v/v was determined. Each of the botanical and nano insecticides was further diluted with 800 ml of water while 1 ml of the two tested synthetic insecticides (Clorpyrifos) was mixed separately with 1000 ml of water. Application of treatments commenced three weeks after planting and this was done early in the morning to avoid photo decomposition of the extracts, with the hand-held sprayer (3 liters Presto sprayer), to prevent drifting. Foliar application was done at 7 days interval and three weekly observations were made.

Data Collection

Amaranthus plants stands (24 plant stands) were selected randomly from each plot and tagged with a black tread from which all the data were collected. Data were collected on plant height, number of leaf and leaf yield and stem, which was calculated by weighing the harvested leaves and converted to t/ha.

Analysis of Proximate Contents of Harvested Leaves

Sample Preparation

The harvested *Amaranthus* leaves were washed, stumps trimmed off (with stainless steel knife) and the knife was used to chop it in smaller pieces for easy air-drying of the samples and this was done separately according to the treatments. The samples were air-dried at room temperature. The dried material obtained was ground to a fine powder and finally packed into airtight polyethylene plastic bottles, labelled appropriately, and stored in the desiccator for three weeks until required for analysis. The dry samples were analyzed for proximate composition and minerals (Ca, Mg, Fe and K). Determinations were carried out by duplicate (AOAC,2005).

Proximate Analysis

Moisture, ash, crude fat, and crude fibre were determined in accordance with the official methods of the association of official analytical chemists (AOAC, 2005), while nitrogen was determined by the micro-kjeldahl method (Pearson, 1976 NR) and the percentage of nitrogen was converted to crude protein by multiplying by 6.25. Carbohydrate was determined by the difference and the results was expressed in percentage.

Mineral Analysis

The minerals in the harvested *Amaranthus* leaves were analyzed from solution obtained when 2.0 g of the samples were digested with concentrated nitric acid and concentrated perchloric acid in ratios 5:3, the mixtures were placed on a water bath for three hours at 80ºC. The resultant solution was cooled and filtered into 100 ml standard flask and made to mark with distilled water (Asaolu *et al.,* 2012). Atomic absorption spectrophotometer (Buck scientific model200A) was used. The result was calculated in mg/100g.

Data Analysis

Data collected were analyzed using Analysis of Variance (ANOVA) with (SPSS version 2021) and significant means were separated with Ducan multiple range text at 5% probability level.

RESULTS AND DISCUSSIONS

The result presented in Figure 1 showed the effect of plant extracts on plant height. Amaranthus plants treated with Chlorprifos had highest plant height (71.5 cm) followed by the plant mixture of leaf and back of *F. exasperata* (68.8 cm) which was significant. While the least plant height was observed (50.6) on the plants treated with *F.exasperata* leaf extracts.

However, the same significant effect was observed among the applied treatments as well as untreated plants on number of leaves as seen in Figure 2. Amaranthus plants treated with Chlorpyrifos had highest number of leaf (29.2) while the least number of leaf (25.6) was recorded on the plants treated with *F. exasperata* leaf.

Leaf yield obtained among the treatments was significant the same, but the plants sprayed with the mixture of leaf and back of *F. exasperata* had highest Amaranth leaf yield (0.84 t/ha) meanwhile, plants treated with *F. exasperata* back extract had higher leaf yield (0.61 t/ha) than that of plants treated with *F. exasperata* leaf (0.52 t/ha). Amaranthus plants sprayed with Chlorpyrifos had 0.79 t/ha leaf yield which was higher than that of plants treated with *F. exasperate* leaf and back extracts as well as that of untreated plants (Fig 3).

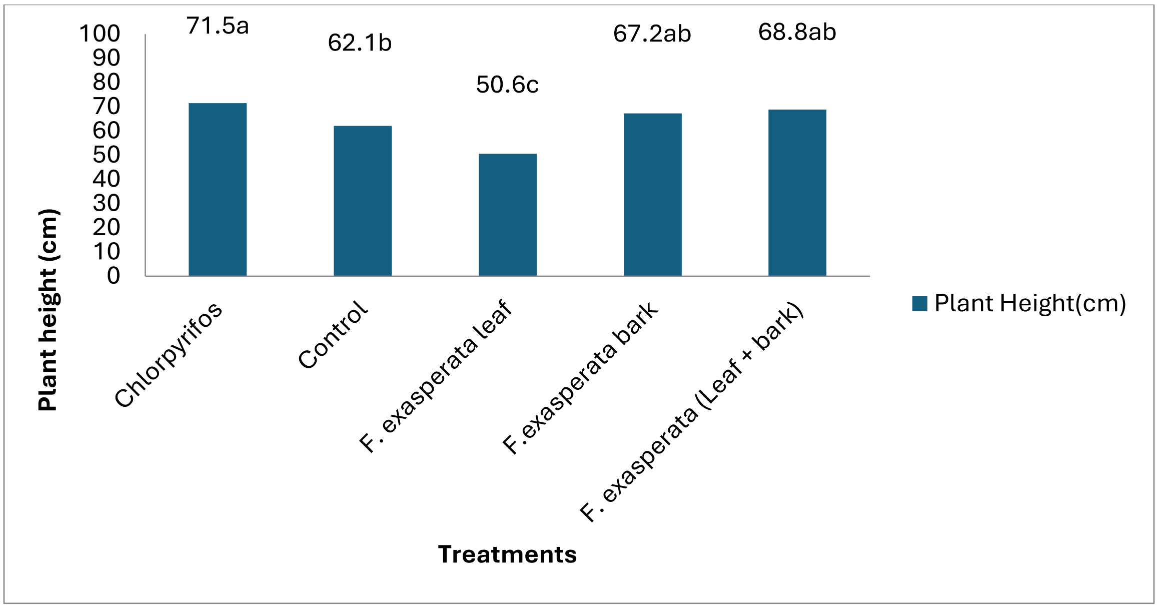

Figure 1: Effects of the extracts on plant heights

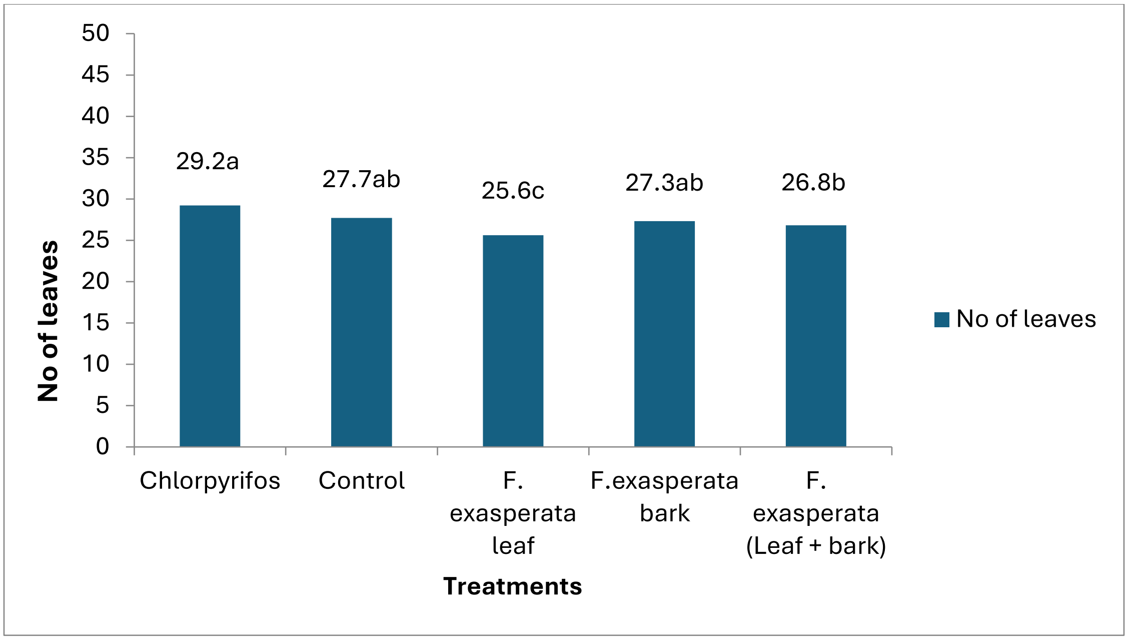

Figure 2: Effects of extracts on the number of leaves

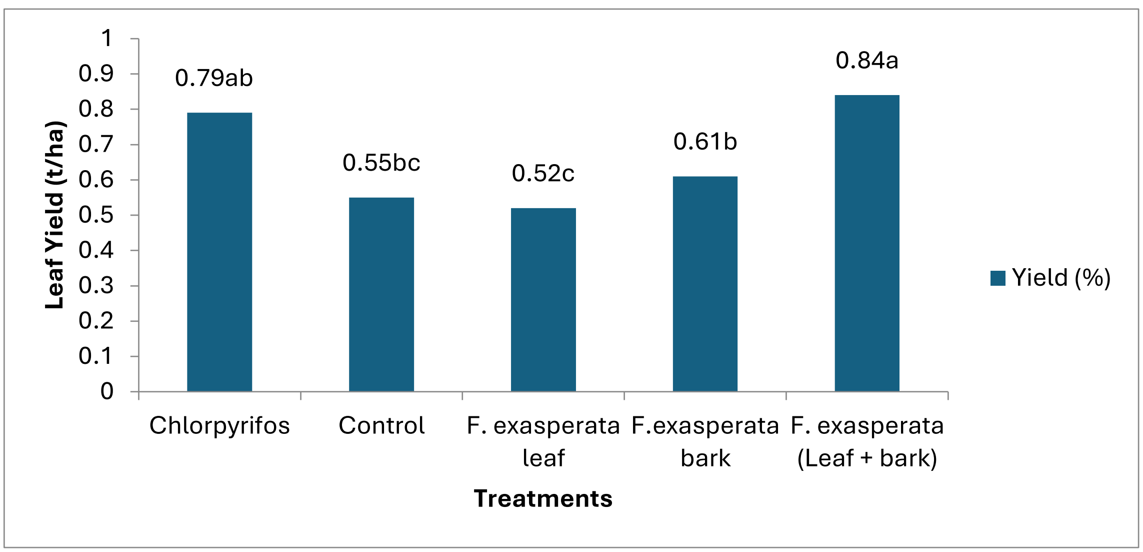

Figure 3: Effects of extracts on the leaf area

As presented in Table 1, significant different was detected among the treatments with respect to the proximate contents. The protein contents observed among the treatments ranged from 18.38 to 24.50% with the harvested leave from plants treated with *F. exasperata* leaf had highest protein contents (24.50 %) followed by the harvested leaves from the plants treated with *F. exasperata* back. However, the least protein content (18.4%) was observed from the leaves obtained on the plants treated with Chlopyrifos. No significant different was detected from the harvested

Amaranthus leaves from plants treated with the mixture of *F. exasperata* leaf and back and untreated plants.

High fibre content (16.2%) was discovered from the harvested leaves from *Amaranthus* plants treated with the mixture of *F. exasperata* leaf and back which was significantly higher than other treatments. Plants treated with the single application of *F. exasperata* leaf and back had higher fibre contents than the harvested leaves from the plants treated with Chlorpyrefos which had the least significant fibre contents (14.4%). Harvested leaves from plants treated with *F. exasperata* leaf extracts had the same significant effects with harvested leaves from untreated plants.

Application of *F. exasperata* leaf had the same significant fat contents (8.10%) with the harvested leaves from *F. exasperata* back extracts while the least fat contents (14.4%) were detected from the leaves from the plants treated with Chlorpyrifos. *Amaranthus* plants treated with the mixture of *F. exasperata* leaf and back had significant lower fat contents (8.00%) compared to the single application of *F. exasperata* leaf and back extracts.

The moisture contents of the harvested leaves ranged from 5 to 7% meanwhile, highest moisture contents (7%) were observed on the harvested leaves from plants treated with Chlorpyrifos while the least moisture content (5%) was from the harvested leaves treated with *F. exasperata* leaf and the mixture of *F. exasperata* leaf and back.

Harvested leaves from the plants treated with *F. exasperata* back has the highest ash contents (14.1%) while harvested leaves from the plants treated with mixture of *F. exasperata* leaf and back has the least ash contents. Ash content (14%) discovered on the harvested leaves from plants treated with *F. exasperata* leaf was higher than the harvested leaves from the plants treated with chlorpyrefos and untreated plants.

The carbohydrate content (47.1%) in the harvested leaves from the plants treated with Chlopyrifos was significantly higher than other treatments. *Amaranthus* plants treated with the combination of *F. exasperata* leaf and back had higher carbohydrate contents (44.3%) than the single application of *F. exasperata* leaf and back. However, none of the single application of *F. exasperata* had the same significant effect on the carbohydrate contents as it was observed on harvested leaves from untreated plants.

Table 1: Proximate analysis of *A. hybridus lin* treated with extracts.

Proximate analysis of *A. hybridus* **lin** as affected by insecticides						
	Proximate contents (%)					
Treatments	Protein	Fiber	Fat	Moisture	Ash	Carbohydrate
Chlorpyrifos	18.38^{d}	14.40^{d}	6.50^{c}	7.00^{a}	13.10^{c}	47.12^{a}
Control	19.50^{c}	16.00^{c}	8.00^{b}	6.00^{b}	13.00^{d}	43.75^{c}
F. exas. Leaf	24.50^{a}	16.00^{c}	8.10^{a}	5.00^{c}	14.00^{b}	37.40^{e}
F. exas. Bark	21.88^{b}	16.10^{b}	8.10^{a}	6.00^{b}	14.10^{a}	39.82^{d}
F. exas. L+B	19.25^{c}	16.20^{a}	8.00^{b}	5.00^{c}	12.30^{e}	44.25^{b}

Means with the same superscript(s) are not significantly different at 5%

Keys:
F. exas – *Ficus exasperata*
F. exas (L+b) – *Ficus exasperata* leaf and bark

Effects of Extracts on Mineral Contents of Harvested *Amaranthus* Leaf

The result presented in Table 2 showed that insecticides applied had effects on the mineral contents. Highest sodium content (3.49) was significant on the harvested *amaranthus* leaf from plants treated with *F. exasperata* leaf extracts followed by the plants treated with *F. exasperate* bark extracts which had 2.55. Least sodium content (2.08) was observed on the harvested *amaranthus* leaves from the plants treated with mixture of *F. exasperata* leaf and back extracts. Sodium contents (2.12) in the harvested *amaranthus* leaf from the plants sprayed with Chlorpyrifos was significantly low compared with sodium content on *amarathus* leaves from plants treated with single application of *F.exasperata* leaf and back extracts as well as that of untreated plants.

Amaranthus leaves harvested from untreated plants had highest calcium content (2.20) meanwhile least calcium content (1.58) was detected in the harvested leaves from the plants treated with *F. exasperata* leaf extracts. The quantity of calcium content (1.64) in the harvested *amaranthus* leaves from the plants treated with *F. exasperata* bark was higher than that of harvested *amaranrthu*s leaves from the mixture of *F. exasperata* leaf and back. *Amaranthus* leaves treated with Chlorpyrifos had higher calcium contents (1.90) than the plants treated with *F. exasperata* extracts.

Harvested leaves from the plants treated with single application of *F. exasperata* leaf and back had lower iron contents than the harvested *amaranthus* leaves from plants sprayed with mixture of *F. exasperate* leaf and back extracts which had 15.5. However, *amaranthus* leaves from the plants treated with *F. exasperata* back extracts had more iron contents (14.1) than the ones harvested from the plants treated with *F. exasperata* leaf extracts which had the least iron contents compared to other applied treatments and untreated plants. Some of the applied *F. exasperata* extracts had significant effects on iron contents as it was observed in the harvested leaves from plants treated with Chlorprifos.

Table 2: Mineral contents of *A.hybridus* as affected by extracts.

Mineral contents of *A. hybridus* as affected by insecticides			
	Nutritional contents (%)		
Treatments	Na	Ca	Fe
Chlorpyrifos	2.12^{d}	1.90^{b}	16.42^{b}
Control	2.18^{c}	2.20^{a}	16.82^{a}
F. exas. Leaf	3.49^{a}	1.58^{e}	12.13^{e}
F. exas. Bark	2.55^{b}	1.64^{c}	14.08^{d}
F. exas. L+B	2.083^{e}	1.60^{d}	15.50^{c}

Means with the same superscript(s) are not significantly different at 5%

Insecticides are the necessary tools in the agricultural activities in other to have reasonable profit. However, negative implication of using insecticides especially synthetic insecticides have been reported. The results obtain from this experiment demonstrated the effects of *F. exasperata* extracts on yield components, proximate contents, and mineral contents of harvested amaranthus leaves. However, the applied insecticides did not have negative effects on plant height, number of leaves and the yield obtained. This suggested that *F. exasperata* can be used in the cultivation of Amaranthus. This was in agreement with the earlier research work by Iwa Ugwu *et al.*, (2019) who reported that application of plant extracts on *Amanthus* hybridus plants did not have significant effects on plant height and total number of leaves.

Results obtained suggested that the insecticides had effects on the nutritional contents of the harvested *amaranthus* leaf. There was a significant variation in the quantity of proximate contents of the harvested *amaranthus* leaf. The observed protein contents ranged from 18.38 to 24.50% meanwhile, plants treated with Chlorpyrifos had the least protein content (18.38) while plots treated with *F. exasperata* leaf had significant highest protein contents (24.50%). According to Ali (2009), plants with the least protein content of 12% is enough as required body protein contents. Aside this, *Amaranthus* leaf as reported by Directorate of Plant Protection (2010) ranged from 15 to 24%. Therefore, none of the protein contents obtained was below the required plant protein. This is an indication that the applied *F. exasperata* extracts applied improved the protein contents of the harvested *amaranthus* leaf. The observed fibre content of the harvested *amaranthus* leaf was within the range of 14.40 to 16.20% which is considerably higher than the one reported (8.61%) by Akubugwo *et al* (2007). However, combination of *F. exsaperata* leaf and back extracts significantly improved harvested *amaranthus* leaf fibre content (16.2) than other treatments but least fibre contents (14.4%) were detected on the harvested leaves from plants treated with Chlorpyrefos.

The fat content of leafy vegetable has been generally reportedly low (Akubugwo *et al.*, 2007). Amaranthus plants treated with F. exasperata leaf and bark singly significantly had highest fat contents (8.1%) while Chlorpyrefos had least fat contents (6.5%) meanwhile the observed fat content is within the stated fat content which ranged from 8.3 to 27% (Sena *et al.*, 1998) except the harvested leaves from amaranth plants treated with Chlorpyrefos. This is an indication that Chlorpyrefos had negative effects on the fat contents.

Ash content (14.1%) observed from the harvested leaves from amaranth plants treated with *F. exasperata* back extracts was higher than other applied treatments and the least ash content (12.3%) was recorded from the amaranth plants treated with the combination of *F. exasperata* leaf and back extracts which was lower than the observed ash content (13.8%) by Akubugwo *et. al.*, (2007). It was observed that the single application of *F. exasperate* leaf and back had higher ash contents than harvested leaves from the untreated *amaranth* plants.

The observed carbohydrate contents from harvested *amaranth* leaves ranged from 37.4 to 47.1%. However, harvested leaves from amaranth plants treated with Chlorpyrefos had highest carbohydrate content (47.12%) while the least carbohydrate content (37.4) was observed from *amaranth* plants treated with *F. exasperata* leaf extracts.

Applied insecticides influenced the mineral contents of the harvested *amaranth* leaves. The observed sodium contents ranged from 2.08 to 3.49 mg/g which was higher than 0.030 – 1.249 mg/g of sodium contents from green vegetables (Gopalan *et al*., 2004) meanwhile, harvested leaves from *amaranth* plants treated with *F. exasperata* leaf extracts had highest sodium content (3.49 mg/g). The calcium content is within the range of 1.60 to 2.20 mg/g, this is below the reported value of calcium content (1.860 – 6.338 mg/g) of green vegetable by Sudeshna *et al.*, (2019) but much higher than the observed calcium value (0.39 – 0.73 mg/g) by Gopalan *et al*., (2004). However, the observed calcium contents in the harvested amaranth leaves treated with *F. exasperata* leaf extracts is higher than that of Chlopyrefos treated plants. This suggests that *F. exasperata* leaf extracts improved the calcium content of the leafy vegetables. The value of iron contents ranged from 12.13 – 16.82 mg/g and this value is considerably higher than 0.054 – 0.415 mg/g reported by Sudeshna *et al*., 2019. Similarly, the observed iron values from this experiment were higher than the reported iron content by Sharif (2011). This is an indication that *F. exasperate* is a major sources iron in the cultivation of leafy vegetable.

CONCLUSION AND RECOMMENDATION

The outcome of this experiment indicates that application of *F. exasperata* extracts did not cause negative effects on the growth of *Amaranth* plants rather it boosts its growth, yield, and nutritional content. It was observed that the combination of leaf and back of *F. exasperata* extracts did not perform better than the single application of leaf and back of the extracts. However, harvested leaves from *amaranth* plants treated with tested plant extracts had higher proximate and mineral contents than the harvested *amaranth* leaves from plants treated with synthetic insecticides (Chlorpyrefos). Therefore, use of *F. exasperata* extract is a major source of improving the proximate and mineral contents of leafy vegetable. It is recommended that further experiment should be conducted on the use *F. exasperata* extract on other crops as nutritional enhancer.

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