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GERMINATION AND GROWTH PERFORMANCE OF TWO LEAFY VEGETABLES IN RESPONSE TO THE ALLELOPATHIC EFFECTS OF *Azadirachta indica* A. JUSS

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ABSTRACT

Biologically active compounds have been reported to be produced by plants and also their inhibitory effects on other plants. This research was carried out to assess the allelopathic effect of leaf leachate of Azadirachta indica A.Juss. (Neem) on the seed germination and growth performances of Hibiscus cannabinus L. and Amaranthus cruentus L. Thirty (30) experimental plastic containers were filled each with 2.5 kg of loamy soil and randomly allocated to the following regimes: control, 20 g, 40 g, 60 g and 80 g of powdered leaves of Azadirachta indica in three (3) replicates for each test crop respectively. It was observed that the response of the Hibiscus cannabinus L. and Amaranthus cruentus L. grown within different composition of Azadirachta indica leafs, were concentration dependent with respect to the germination and growth parameters studied at 2nd WAP. But at 4th-10th WAP, it was observed that all treatments grew well above the control. This indicates that Azadirachta indica L. has allelopathic effect on the studied vegetables and therefore it could be used for biological weed control and growth improvement.

Keywords: - Allelopathy, *Amaranthus cruentus, Azadirachta indica,* Concentration, *Hibiscus cannabinus*

INTRODUCTION

In an area of land where different plants species grows together in close relationship, interaction is bound to occur. This interaction may range from inhibition, competition, domination, overshadowing, and growth promotion. Researchers have often ignored allelopathy as a possible mechanism in their tree-crop interaction studies (Horsley 1977).

Allelopathy may also play an eminient role in intraspecific and interspecific competition and may determine the type of interspecific association. The role of allelochemicals is well documented (Alagesaboopathi, 2011). Allelopathy is a biological phenomenon where by certain plants produce a biochemically active compounds that have positive or negative effects on neighboring organisms around them (Ogunkunle e*t al.,* 2013). Allelopathic interaction involves the production and release of chemical substances (allelochemicals). Such biological phenomenon has been reported by Ogunyemi and Odewele (2011), Vaithiyanathan *et al., (*2014), all reported the allelopathic effects of *Azadirachta indica* A. Juss. on the germination of different seeds.

According to them, toxic allelochemicals may inhibit shoot/root growth, nutrient uptake, or attack a naturally occurring symbiotic relationship thereby destroying the plant's usable source of a nutrient. The consequent effects may be inhibited or retarded germination rate, reduced root or radicle and shoot or coleoptiles extension, lack of root hairs, swelling or necrosis of root tips, curling of the root axis, increased number of seminal roots, discoloration, reduced dry weight accumulation and lowered reproductive capacity (Ahmed and Shalaby 2012). Plants release allelochemicals into the environment via root exudation, leaching by rainfall, or decomposition of plant residues (Inderjit and Duke, 2003). These allelochemicals are present in almost all plant parts such as leaves, stems, roots, flowers, seeds bark and buds (Weston and Duke, 2003). The leaves has been reported to produced much allelochemicals compare to the roots, stem bark and fruits (Vaithiyanathan *et al.,* 2014). *Azadirachta indica* A.Juss. is an arboreal species that

originated from India, where it is known as "Neem". This plant is considered to be the "drugstore of the village" by the Indian population because of the large number of medicinal formulations that can be prepared from it (Isman, 2000). *A. indica* seeds were introduced in Brazil in the 1970s, where it has been used as a phytochemical biopesticide (Martinez, 2002).

Thus this investigation was carried out to study the allelopathic effect of *Azadirachta indica* A.Juss. plant leaves on the germination and growth performance of *Amaranthus cruentus* L. and *Hibiscus cannabinus* L.

MATERIALS AND METHODS

Fresh leaves of *Azadirachta indica* A. Juss were collected from matured tree. In order to get representation of the entire tree canopy, the leaves were taken from the lower, middle and top portions of each tree. However, dry or senescent leafs were avoided. Viable seeds of the test vegetables, *Amaranthus cruentus* L. and *Hibiscus cannabinus* L., were obtained from local farmers in Gombe State. The plant materials and soil sample(s) were collected in June, 2016 at the study area.

The leaves were air dried and grinded into powder using mortar and pestle. The resultant powders were then weighed using an electronic weighing balance each into four different treatments (20g, 40g, 60g and 80g). To determine whether the experimental seeds were viable, laboratory bioassay of the seeds was carried out in a Petri-dish using distilled water and filter paper to serve as the growth media. All Procedures for the pot experiment were carried out as modified by Ogunkunle *et al.,* (2013), Sixty experimental pots were used for the study of the allelopathic effects of the leaves of *Azadirachta indica* on *Amaranthus cruentus* L. and *Hibiscus cannabinus* L. The experiment was designed into five treatments and each treatment was replicated three (3) times, making fifteen for the two aforementioned vegetables. Loamy soil was collected on farmlands on the University campus and spread on a clean surface under the sun for two days; this was aimed at destroying all form of germinating seeds present in the soil. 2.5 kg of the loamy soil was then weighed into thirty different experimental pots using electronic weighing balance. Each replication of the five treatments were mixed with the four different regimes (0g, 20g, 40g, 60 g and 80 g) of the powdered leaves prepared as treatments. The mixture in the experimental plastic containers were moistened to saturation with borehole water and left for thorough agglomeration of the powdered leaves with the soil matrices for three days. Twenty seeds of *Amaranthus cruentus* L, and forty seeds of *Hibiscus cannabinus* L were respectively counted and sprayed over the soil in the experimental pots, the top soil was then mixed not exceeding the depth of 1.5 cm. The number of germinated seeds was counted 2WAP and germination percentage was calculated by using the following formula.

$$\text{Germination percentage} = \frac{\text{Total number of seeds sown}}{\text{Number of germinated seeds}} \quad X100$$

Measurements of morphological parameters started two (2) weeks after planting (WAP) and lasted for ten (10) weeks with an interval of two weeks. The morphological parameters scored include: Plant height, leaf length and breadth, stem girth and leaf area. The plant height, leaf length and breadth were measured with a standard meter rule while the stem girth was measured with an electronic digital caliper (Titan 23175 model). The leaf area was calculated according to Pearcy *et al.,* (1989):

Leaf Area = (L X B) K

Where L= length of leaf, B = maximum width and K= 0.72

Data generated were subjected to analysis of variance (ANOVA) to show differences among
the means and were separated using Duncan's Multiple Range Test (DMRT) at P<0.05, and finally the results were tabulated.

RESULTS AND DISCUSSION

The results, revealed that the response of the two leafy vegetables (*Amaranthus cruentus* and *Hisbiscus cannabinus*) growth within different levels of leaves composition of *Azadirachta indica* are concentration dependent. Statistically, there was significant difference between the treatments. The results of the germination assay revealed that mean germination of the leafy vegetables decrease with increase in concentration (Table 1). The trend was earlier observed by Jadhar and Gayanar (1992) who found the percentage germination, plumule and radicle length of rice and cowpea decreased with increasing concentration of *Acacia auriculiformis* leaf leachates. Adeyemi *et al*. (2015) while working on germination and seedling development of seeds from different *Parkia biglobosa* trees reported that seeds from different *Parkia* populations responded differently to light effect.

The findings of this research show that *Azadirachta indica* possesses certain phytochemicals (allechemicals) that inhibits seed germination and also the growth parameters of the studied plants grown within different composition of the studied plant, the effects observed were all concentration dependant with a significant difference between all treatments. This shows that the leaves of *Azadirachta indica* has allelophatic effects on the studied plant. These findings are in conformity with that of Folarin *et al.* (2015), who reported that the effects of *Vitelleria paradoxa* on some leafy vegetables namely (*Celosia argentea*, *Amaranthus hybridus* and *Amaranthus hypochondriacus*) were concentration dependant. Many researchers have stressed the allelopathic importance of many trees in weeds control and plant improvement such as *Parkia biglobosa*, *Anacardium occidentale, Senna alata* and many more.

In the *Hibiscus cannabinus* and *Amaranthus cruentus*, control treatments were significantly higher than other treatment for all the growth parameters studied at 2WAP while at 4-10 WAP at different intervals the treatments are above the control at p< 0.05 (Table 2; Figure 1-6). Folarin *et al*. (2015) reported the allelophatic effects of leaf leachates of *Vitellaria paradoxa* on the growth parameters of *Celosia cruentus*, *Amaranthus cruentus* and *A. hypochondriacus*. Gulzar and Siddiqui (2014) reported the allelophatic effect from aqueous extracts of *E. alba* showed an inhibitory effect on seed germination and seedling growth of test species.

The germination *Amaranthus cruentus* were significantly reduced in all treatments at 2nd -4th WAP except for 20g and 40g (Table 1) which does not significantly differs with the control at 2WAP in terms of stem girth. In terms of leave area there was no any significant different 2nd – 4th WAP in (Table 2), with increasing mass of powder. The allelophatic effects on *Hibiscus cannabinus* also agrees with the trend of concentration dependency except for 4WAP in stem girth of 20g it shows no significant difference with the control in treatment (Figure 3). The results generally show that the allelophatic effects are greatly exerted during the first and second week of planting, however from 4th - 10th WAP, an increase was recorded in the growth indices (Figure 1-6). This findings agree with the findings of Folarin *et al.* (2015), which reported that at 2nd WAP, the allelophatic effects of *Vitelleria paradoxa* was greatly reduced but 4th -8th WAP, the inhibition effects decreases resulting in increase in the growth were possibly due to leaching and mineralization (Ogunkunle, *et al*., 2013).

Table 1: Allelopathic effects of *Azadirachta indica* leaves on the Germination of *Hibiscus cannabinus* L. and *Amaranthus cruentus* L.

Species	**Treatment**	**Mean Germination**	**Mean G.%±S.D**
Hibiscus cannabinus	Control	18.66	93.3±7.64 d
	20g	12.33	61.7±7.64 c
	40g	6.67	33.3±11.6 b
	60g	2.67	13.3±2.89 a
	80g	3.00	15.0±10.0 a
Amaranthus cruentus	Control	35.33	88.3±8.78 c
	20g	20.67	51.7±11.81 b
	40g	6.93	17.3±7.50 a
	60g	2.00	5.00±2.50 a
	80g	3.00	7.50±2.5 0a

Means within the column followed by the same letters are not significantly different at p<0.05.
H. cannabinus n=20, *A. cruentus* n=40, where n is seed number, G=Germination.

Table 2: Allelopathic effects of *Azadirachta indica* leaves on the Leave area of *Hibiscus cannabinus* L. and *Amaranthus cruentus* L.

Species	Treatment	2WAP	4WAP	6WAP	8WAP	10WAP
Hibiscus	Control	6.33±0.52c	10.34±0.69 a	21.9±0.61a	24.9±1.03a	27.18±1.86a
cannabinus	20g	4.17±0.74 ab	18.08±1.51 a	23.8±4.19a	29.1±2.99a	36.37±1.59a
	40g	4.88±0.65b	14.08±1.17ab	47.2±3.10b	59.7±7.04c	69.43±12.9c
	60g	3.57±0.95 ab	7.66±6.73 ab	45.6±39.8b	52.9±49.0c	72.11±66.6c
	80g	1.68±1.47 a	5.95±6.05 b	37.61±32.6b	41.7±36.1b	46.10±39.9b
Amaranthus	Control	0.23±0.06b	0.63±0.20 a	1.64±0.89 a	7.50±1.78a	8.39±2.41 a
cruentus	20g	1.02±1.61c	0.71±0.13 a	3.64±2.57 a	7.93±2.77a	13.43±5.76 b
	40g	0.12±0.06ab	0.63±0.70 a	11.8±7.08 b	18.7±1.44a	21.82±1.50 b
	60g	0.06±0.06a	0.92±0.19 a	7.44±9.88 ab	9.61±13.0a	10.83±13.5 a
	80g	0.03±0.00a	6.50±5.46 b	47.1±12.0 c	55.8±12.2b	59.59±13.5 c

Means within the column followed by the same letters are not significantly different at p<0.05.

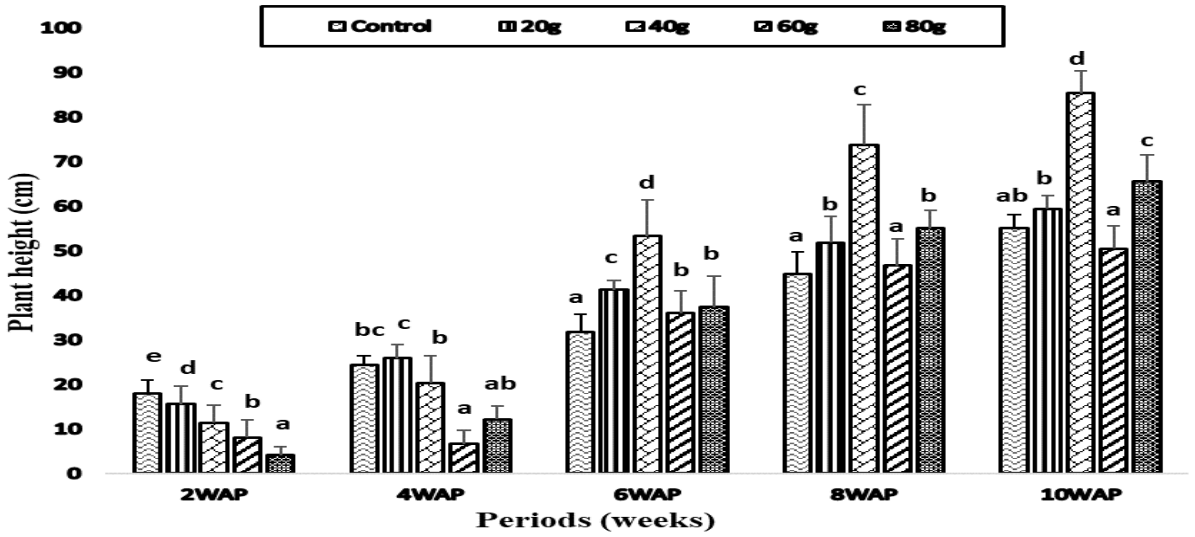

Figure 1: Variations in the plant height of *Hibiscus cannabinus* as influenced by leaf powder of *Azadiracthta indica*

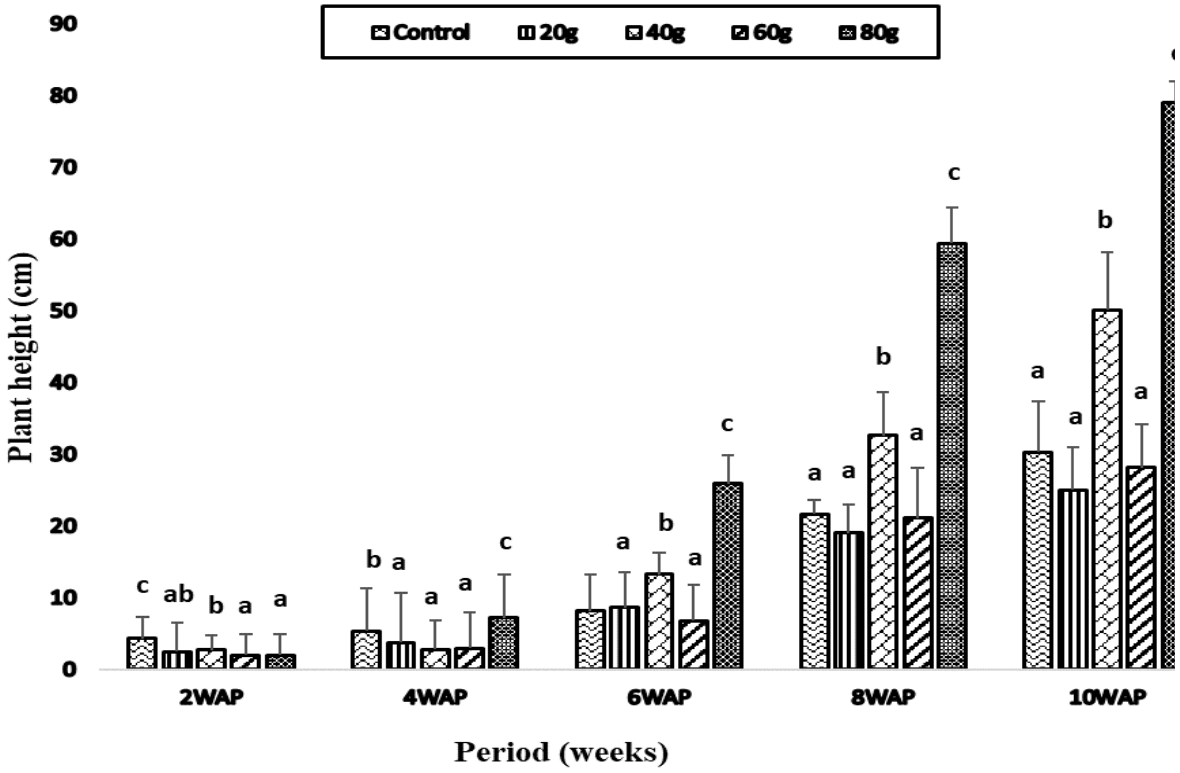

Figure 2: Variations in the plant height of *Amaranthus cruentus* as influenced by leaf powder of *Azadiracthta indica*

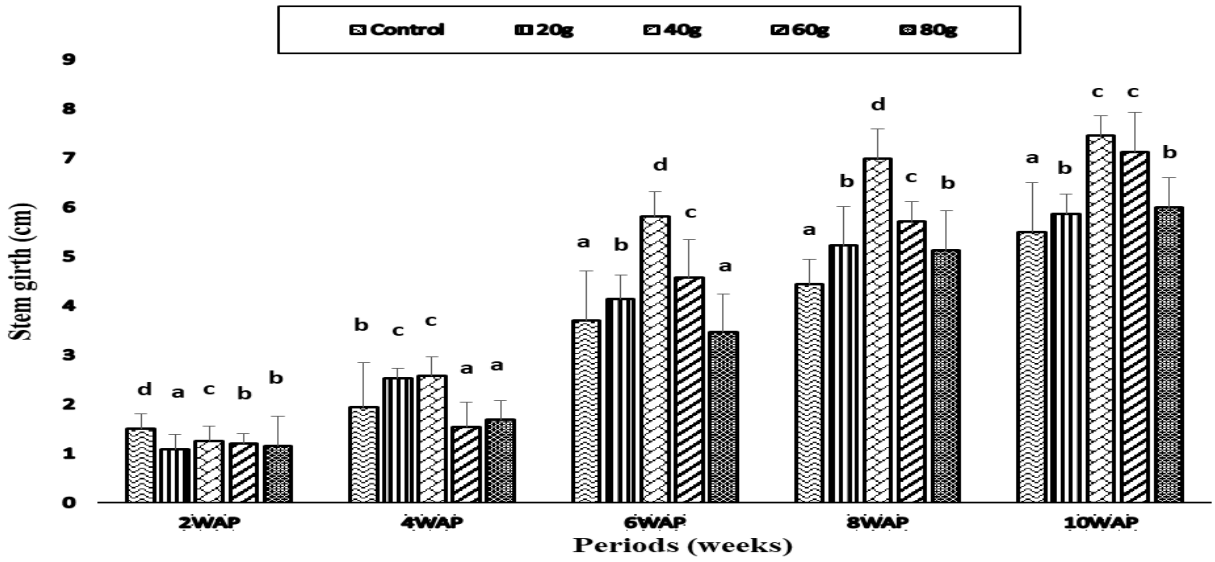

Figure 3: Variations in the stem girth of *Hibiscus cannabinus* as influenced by leaf powder of *Azadiracthta indica*

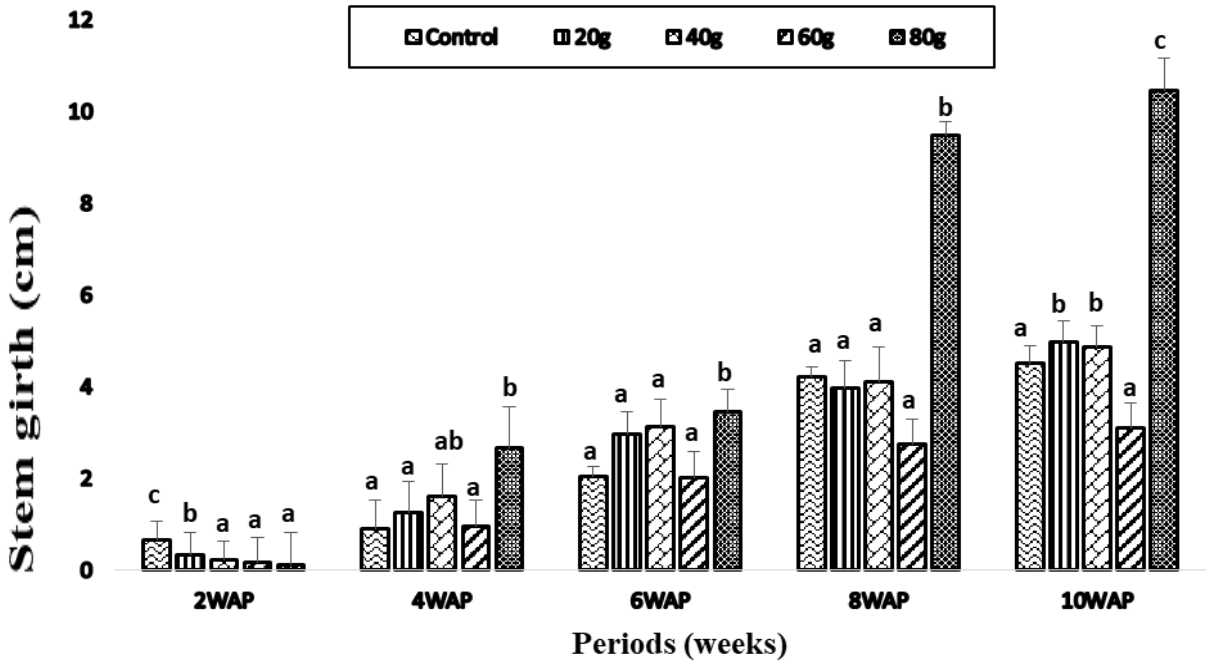

Figure 4: Variations in the stem girth of *Amaranthus cruentus* as influenced by leaf powder of *Azadiracthta indica*

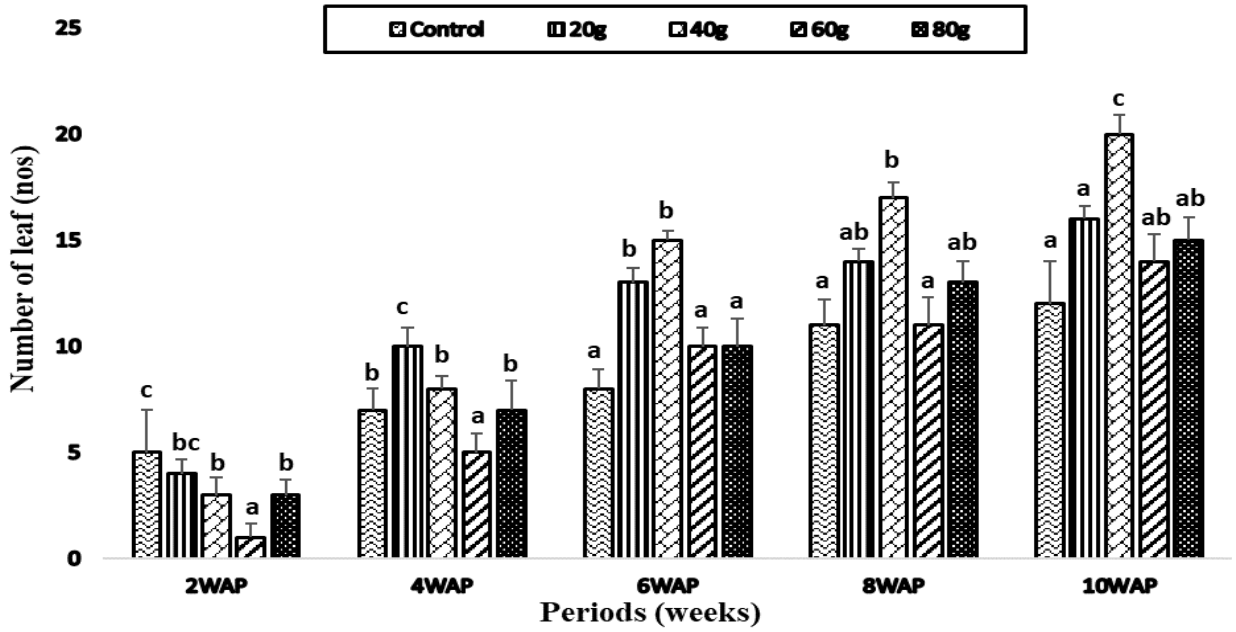

Figure 5: Variations in the plant height of *Hibiscus cannabinus* as influenced by leaf powder of *Azadiracthta indica*

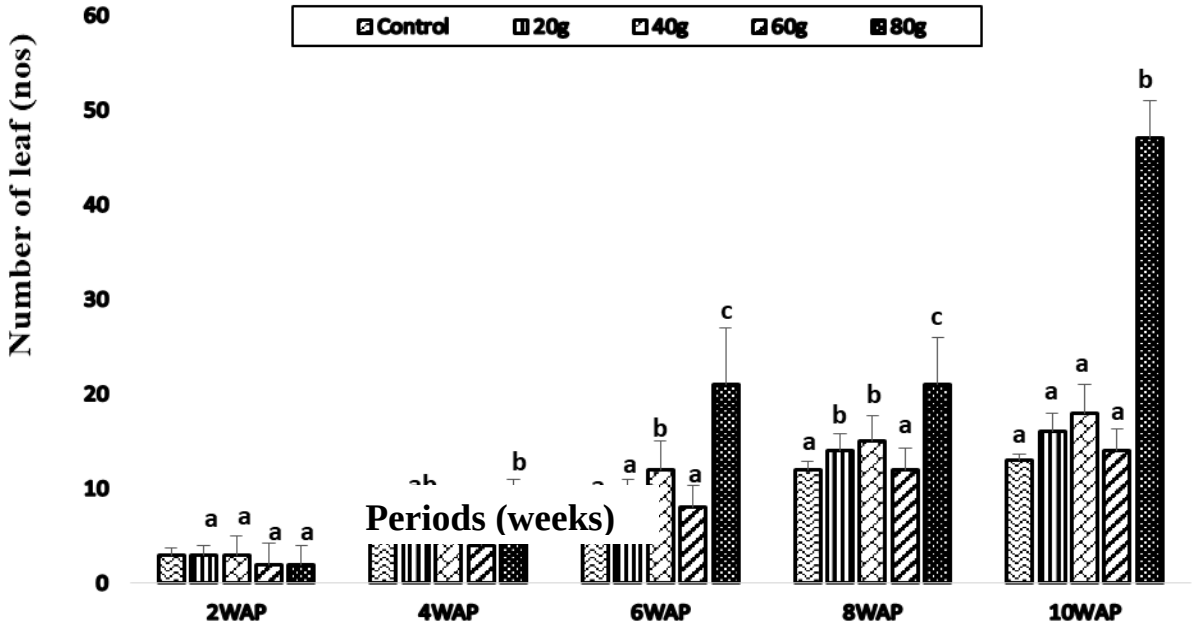

Figure 6: Variations in the number of leaves of *Amaranthus cruentus* as influenced by leaf powder of *Azadiracthta indica*

CONCLUSION

The research indicates that *Azadirachta indica* leaves exhibits strong allelopathic effect and possesses significant growth inhibitory ability on *Hibiscus cannabinus* L. and *Amaranthus cruentus* L. These results suggest that *Azadirachta indica* could have allelochemicals that are useful natural resources for developing biological agrochemicals for farming activities with no detrimental effects to the soil and environment as in the case of synthetic agrochemicals.

REFERENCES

Adeyemi, C.O, Olorunmaiye, K.S., Orhuamen, E.O and Ogunsola, K.O (2013). Germination and Seedling Development of Seeds from Different *Parkia biglobosa* (Jacq) G. Don Trees. *Notulae Scientia Biologicae,* 5(1): 120-126

Ahmed, Y. M. and Shalaby, E. A. (2012). Effect of different seaweed extracts and compost on vegetative growth, yield and fruit quality of cucumber. *Journal of Horticultural Science and Ornamental Plants*, 4(3): 233 – 240.

Alagesaboopathi, C. (2011). Antimicrobial potential and phytochemical screening of *Andrographis affinis* Nees- an endemic medicinal plant from India. *International Journal of Pharmacy and Pharmaceutical Sciences*, 3(2):157-159.

Folarin, O., Ogunkunle, C., Oyedeji, S., and Kolawole, S. (2015). Growth Response of Three Leafy Vegetables to the Allelopathic Effect of *Vitellaria paradoxa*. *Notulae Scientia Biologicae*, 7(4): 460-463.

Gulzar, A. and Siddiqui, M.B. (2014). Allelophatic effects of aqueous exracts of different parts of *Eclipta alba* (L.) Hassk. on some crop and weed plants. *Journal of Agricultural Extension and Rural Development*, 6(1): 55-60

Horsley, S.B. (1977). Allelopathic inhibition of black cherry by fern, grass, goldenrod and aster. *Canadian Journal of Forest Research.* **7**: 205-216.

Inderjit, K. and Duke, S.O. 2003. Ecophysiological aspects of allelopathy. *Planta*, 217: 529-539.

Isman, M.B. (2000). Biopesticides based on phytochemical. In O. Koul, G. S. Dhaliwal, K. Koul (eds). *Phytochemical Biopesticides*. Overseas Publishers Association, Amsterdam. pp. 346-876

Jadhar, B.B. and Gayanar, D.G. (1992). Allelophatic effects of *Acacia auriculiformis* on germination of rice and cowpea. *Indian Journal of Plant Physiology*, 35: 86-93.

Musa, D. D., Esson, A. E., Shuaibu, B.U. and Adebola, M.I. (2016). Allelopathic effect of *Senna obtusifolia* on the germination and growth of cowpea (*Vigna unguiculata*) and maize (*Zea mays*). *African Journal of Science and Research*. 1:71-74.

Ogunkunle, C. O., Kolawole, O. S., Oyedeji, S., and Fatoba, P. O., (2013) Variations in Growth Performance of *Amaranthus cruentus* and *Celosia argentea* in Response to Leaf Allelopathy of *Anacardium occidentale*. *International Journal of Phytofuels and Allied Sciences.* 2 (1):17-12

Ogunyemi, S, and Odewele, F. (2011). The effect of neem (*Azadirachta indica* A. Juss) on seed of *Senna sophera L. Roxb* and *Crotalaria onchroleuca G. Don. The African Journal Plant Science and Biotechnology*. 5(1)**,** 63-65.

Pearcy R.W., Schulze, E.D. and Zimmermann, R. (1989). *Measurement of transpiration and leaf conductance*. Plant Physiological Ecology. Springer Netherlands pp 137-160.

Vaithiyanathan, T., Soundari, M., Rajesh, M., and Sundaramoorthy, P. (2014). Allelopathic effect of *Azadirachta indica* L. on the germination of *Abelmoschus esculentus* L. *International Journal of Natural Sciences*. 10:12-13

Weston L.A. and Duke S.O. (2003): Weed and crop allelopathy. *Critical Review in Plant Science*, 22: 367–389.