



**HERBICIDAL POTENTIALS OF BOTANICAL FOR THE CONTROL OF
ALECTRA VOGELII ON GROUNDNUT (*Arachis hypogaea* L.) VARIETIES IN
SUDAN SAVANNA OF NIGERIA**

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ABSTRACT

A field experiment was carried out during 2018 rainy season at Bayero University Research Farm (11° 57'N, 8°24'E) and Garko, in Garko local government area, Kano State (22°11'N, 68°008'E) to evaluate the effect of groundnut varieties and plant botanicals on the control of *Alectra vogelii* in the Sudan savanna of Nigeria. The treatments consisted of four (4) groundnut varieties (*Kwankwaso*, *Maibargo*, *Sabaiya* and *Samnut-24*) and six (6) plant extracts (*Azadirachta* leaf powder, *Tamarind* leaf powder, *Ficus* species leaf powder, *Parkia* fruit powder, and control). These were factorially combined and laid out in a Randomized Complete Block Design (RCBD) replicated three times. Data were collected on *Alectra* were number of *Alectra* infested stands per plot and number of *Alectra* per stand while on ground nut were pod yield per plant and pod yield per hectare. The results obtained shows that, plant extracts significantly reduced the number of *Alectra* per stand as compared to control plots while *Sabaiya*, *Maibargo* and *Samnut-24* have recorded the lowest number of *Alectra* per stand. *Parkia* fruit powder and *Tamarind* leaf powder recorded the highest pod yield, Application of plant extracts significantly reduced the *Alectra* germination and infestation level. Thus, *Tamarind* leaf powder along with *Sabaiya* were found to be effective on *Alectra* control and produced higher pod yield and can therefore be recommended for *Alectra* control in the study area.

Keywords: Herbicidal, Botanical, *Alectra*, Control, Groundnut, Varieties.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a leguminous oilseed crop cultivated in the semi - arid and sub - tropical region of the world (Ajeigbe *et al.* 2015). It is grown in nearly 100 countries on six continents between 40° N and S of the equator on nearly 24.6 m ha, with a production of 41.3 m.t. and productivity of 1676 kg ha⁻¹ during 2012. China, India, Nigeria, USA and Myanmar are the leading groundnut producing countries in the world. Asia, with 11.6 m ha (47.15%), and Africa, with 11.7 m ha (47.56%), hold maximum global area under groundnut. Developing countries in Asia, Africa and South America account for over 97% of world groundnut area and 95% of total production. However, the productivity of Asia (2217 kg ha⁻¹) and Africa (929 kg ha⁻¹) is very poor as compared to Americas (3632 kg ha⁻¹) (FAOSTAT 2014) Groundnut is a good source of protein (25-34%), cooking oil (48-50%), and vitamins. The haulms have market value and are used as livestock feed in many parts of the world especially in the dry season when the fodder is in high demand. It improves soil fertility through nitrogen fixation, thereby increasing the productivity of other crops when used in rotation or in a cereal cropping system (Garko *et al.*, 2016). Despite the potential benefit of groundnut, its productivity has been declining in African countries due to use of low-yielding varieties, weed competition, poor adoption of agronomic practices and limited extension services (Ajeigbe *et al.*, 2014). *Alectra vogelii* is a major biotic constraint to groundnut production. Yield loss due to *Alectra* infestation was estimated to be 30 to 80% in Africa (Shinggu, 2015). In combination with other pests, weeds can reduce crop productivity by 100%. Yield losses due to weeds of 15% are reported for peanut production in Nigeria and a 30 to 50% reduction in Bambara nut yields in South Africa (CABI, 2019). *A. vogelii* imposes an additional stress to groundnut farmers who have little capacity for investment in crop production



(Karanja *et al.*, 2013). It is intimately involved with the host and has so much metabolic overlap with the host that differential treatments are very difficult to develop for its control. *A. vogelii* is closely associated with the host root, concealed underground, and undiagnosed until it irreversibly damage the crop (Neeraj, 2014). The low productivity of groundnut in African countries may be attributed to use of low-yielding varieties, weed competition, poor adoption of agronomic practices and limited extension services (Ajeigbe *et al.*, 2015). *Alectra vogelii*, is the major constrains to the production of groundnut, cowpea and other leguminous crops in sub-Saharan region of Africa, and its presence can result into total crop failure (Shinggu, 2015). Yield losses of 15% are reported for peanut production in Nigeria and up to 30 to 50% reduction in Bambara nut yields in south Africa (CABI, 2019) Herbicide use for controlling parasitic weeds is problematic because of the intimate association of parasite and host. Environmental impacts are linked with the use of synthetic herbicides, and there can be effects on non-target organisms (Bill, 2011). A botanical is a plant or plant part valued for its medicinal or therapeutic properties (U.S.A., 2011). The use of botanicals may be one of these alternatives since the plant materials are widely available and at minimum or no cost. Botanicals will not only eliminate the need of application equipment, but will also reduce the cost of production and increase yield (Lado *et al.*, 2018).

MATERIALS AND METHODS

The experiment was conducted during the wet season of 2018 at the Teaching and Research Farm of Faculty of Agriculture, Bayero University Kano (latitude 11°57'N and longitude 8°24'E) and Garko, (Latitude 22° 11'N, longitude 68° 008'E), Kano State, Nigeria. The experiment consisted of four groundnut varieties and five botanicals. The varieties used were *Kwankwaso*, *Maibargo*, *Sabaiya* (obtained at local market) and Samnut-24 (obtained from ICRISAT). The plant botanicals used were *Azadirachta indica* leaf powder, *Tamarindus indica* leaf powder, *Ficus* species leaf powder, *Parkia biglobosa* fruit powder and control. These were factorially combined and laid out in randomized complete block design (RCBD), replicated three times. Plots consisted of six rows of 0.75 m apart and 3 m long (13.5 m²); while the net plot size was 3 m × 2.6 m (7.8 m²). The phytochemical analysis of the plant botanicals was done in the analytical laboratory, Department of Chemistry, Yobe State University, Damaturum, Nigeria with Gas Chromatography-Mass Spectroscopy (GCMS) using the high-performance thin layer chromatography method as in Sahira and Catherine (2015). The land was ploughed, harrowed and made into ridges 75 m apart, demarcated into plots (9 m²) and replicated three times. An alley of 0.5 and 1.0 m were left between plots and replication, respectively. Planting holes were artificially infested with *A. vogelii* seeds as described by Karanja *et al.* (2013)

Leaves and fruits of botanicals were collected and dried under shade and grinded into fine powder before application into sowing hole at the rate of 3 g per hole on top of the *Alectra* soil mixture during sowing. The groundnut seeds were manually placed in a planting hole (on top of the *Alectra* and plant botanicals) at spacing of 75 cm × 20 cm using two seeds per hole. Fertilizer was applied at the rate of 20 kg N, 54 kg P₂O₅, and 20 kg K₂O ha⁻¹ using NPK (15:15:15) and single superphosphate (18% P₂O₅) at two weeks after sowing (WAS) as side dressing. Weeds other than *A. vogelii* were controlled manually by using hoes at 3 and 6 weeks after seeding (WAS). Harvesting was done manually after the crop had reached physiological maturity by digging and lifting the crop and allowing material to dry. The pods were manually handpicked

Data were collected on *Alectra* were (number of *Alectra* infested stands per plot and number of *Alectra* per stand) while on ground nut were (pod yield per plant, pod yield per hectare,) Data generated were subjected to analysis of variance (ANOVA) using GenStat discovery Edition version 7. Significant treatment means were separated using the SNK (Student-Neuman-Keuls) test.

RESULTS AND DISCUSSION

Table 1 shows the results of phytochemical analysis of the plant botanicals used. A total of ten chemical groups of secondary metabolites compounds were detected in all samples. *Azadirachta* leaf powder and *Parkia* fruit powder had nine phytochemical compound types (flavonoids, alkaloids, glycosides, coumarins, terpenoids, phenols, tannins, anthraquinones, and saponins), while *Tamarind*



leaf powder had seven types (flavonoids, alkaloids, coumarins, terpenoids, phenols, anthraquinones and saponins). However, *Ficus* spp. Leaf powder only had eight phytochemical compound types (flavonoids, alkaloids, glycosides, coumarins, terpenoids, phenols, tannins and saponins). Application of plant botanicals is associated with fewer number of groundnut stands infested with *Alectra*. This indicated that the botanicals can be used to suppressed *Alectra* infestation in groundnut. This could be associated with the allelopathic effect of the plant botanicals on *Alectra* germination.

Number of *Alectra* infected stands was significantly influenced by plant botanicals in both locations. All the plant botanicals recorded significantly lower *Alectra* infestation compared to control which recorded the highest in both locations. This could possibly be due to the presence of phytochemical compounds such as coumarins, phenols, terpenoids and tannins in the botanicals which act as defense mechanism against parasitism and predation from other organisms, including competition by plants. These results are in line with those reported by Shinggu (2015) who noted that plant botanical powder delay *Alectra* emergence, reduced *Alectra* count and number of plants infested by *Alectra* in cowpea. Lado *et al.* (2018) also reported lower number of *Striga gesnerioides* L. when *Parkia* fruit powder was applied to cowpea stands. Shinggu, (2015) stated that, treating the planting holes with *Azadirachaindica* seeds powder, *Azadirachaindica* leaf powder *Eucalyptus*spp leaf powder, *Anacadiumoccidentale* leaf powder, *Tamarindusindica* leaf powder and *Carica papaya* leaf powder delayed *Alectra* emergence, reduced number of *Alectra* shoot and number of plants infested. The interaction between varieties and plant botanicals on number of *Alectra* infected stands were not significant in both locations.

Groundnut varieties had no significant effect on number of *Alectra* per stand at BUK (Table 2). However, varieties significantly differ in number of *Alectra* per stand at Garko. Kwankwaso recorded the highest number of *Alectra* per stand at Garko. This indicates that this variety is highly susceptible to *Alectra*. Justine *et al.*, (2009) stated that, most of the groundnut varieties are susceptible to *Alectra* inversion, while Samnut-24 recorded the lowest. This implies that Samnut – 24 may have some resistant to the parasite and can be used in managing the parasite. Similar result was reported by Yohanna *et al.* (2010) on the related strain, where Samnut-18 had a low *Alectra* shoot number in both field and screen house experiment. The *Azadirachta* leaf powder treated plots recorded the lowest number of *Alectra* per stand compared to other plant botanicals at BUK. This might be as a result of the phyto-chemicals (i.e. coumarines, phenols and saponins) found in it, which acts as defense mechanisms against pathogens, parasite and predators. Stefano *et al.*, (2017), stated that, the botanical family of Asteraceae (*Artemisia annua* and *Xanthium strumarium*) are source of natural herbicides. More than ten of Asteraceae species showed a germination inhibitors of *Amaranthus retroflexus* and *Setaria viridis*. The present finding supports those of Shinggu (2015) who concluded that the use of *A. indica* seed and leaf powder reduced *Alectra* count and number of *Alectra* infested plants in cowpea. Studies by Parvez *et al.* (2015) also confirmed that *Tamarind* leaf extract inhibits weed growth by 30 to 75%. The interaction between groundnut varieties and plant botanicals on number of *Alectra* per stand was not significant in both locations.

Table 1. Phytochemical Composition of Plant Botanicals

S/No	Phytochemical Constituents	<i>Ficus</i>	<i>Tamarind</i>	<i>Parkia</i>	<i>Azadirachta</i>
1	Flavonoids	+	+	+	+
2	Alkaloids	+	+	+	+
3	Glycosides	+	-	+	+
4	Coumarins	+	+	+	+
5	Terpenoids	+	+	+	+
6	Phenols	+	+	+	+
7	Tannins	+	-	+	+
8	Anthraquinones	-	+	+	+
9	Steroids	-	-	-	-
10	Saponins	+	+	+	+

+ = present of phytochemical constituent, - = absent of the phytochemical constituent

Table 2. Effect of Groundnut Varieties and Plant Botanicals on *Alectra* Infestation at BUK and Garko

Treatments	Locations			
	BUK	Garko		
	No of <i>Alectra</i> affected stand	No of <i>Alectra</i> per stand	No of <i>Alectra</i> affected stand	No of <i>Alectra</i> per stand
Varieties (V)				
Kwankwaso	6.47	1.70	4.87	1.97 ^a
Maibargo	6.13	1.3	6.20	1.72 ^{ab}
Sabaiya	6.53	1.22	5.47	1.68 ^{ab}
Samnut 24	7.73	1.44	5.33	1.10 ^b
Level of probability	0.650	0.081	0.544	0.041
S E ±	1.332	0.18	0.649	0.21
Plant botanicals (P)				
Azadirachta Leaf powder	4.08 ^b	1.00 ^b	4.08 ^b	1.76
Tamarind Leaf powder	4.50 ^b	1.41 ^{ab}	5.08 ^b	1.21
Ficus spp. Leaf powder	5.00 ^b	1.36 ^{ab}	3.33 ^b	1.37
Parkia fruit powder	5.83 ^b	1.71 ^a	4.75 ^b	1.86
Control	14.16 ^a	1.68 ^a	10.08 ^a	1.89
Level of probability	0.0470	0.007	<.001	0.170
S E ±	1.409	0.20	0.726	0.24
Interaction				
V x P	0.687	0.356	0.490	0.312

Means followed by the same letter(s) in the column are not significantly different at 5% level of probability using student- Newman keuls Test.

Varieties had no significant effect on pod yield plant⁻¹ in both locations, but significantly influenced pod yield per hectare at Garko (Table 2). *Sabaiya* recorded the highest pod yield per hectare at Garko. This might be as a result of its good adaptation to the local environment or its growing habit (runner type). Plant botanicals significantly affected pod yield plant⁻¹ and ha⁻¹ in both locations (Table 2). *Tamarind* leaf powder consistently recorded higher pod yield plant⁻¹ than other plant botanicals in both locations. The control plot recorded lowest pod yield plant⁻¹ in both locations. This could be attributed to the relatively high levels of phenols in *Tamarinds* leaf which is essential for reproduction, and flavonoids which stimulate root nodule formation as reported by Maria *et al.* (2015). Increased nodule number implies increased supply of nitrogen which enhances growth and yield of crops. This implies that there may be more N for subsequent crops in rotation. Interaction between groundnut varieties and plant botanicals on pod yield plant⁻¹ was not significant in both locations. *Sabaiya* consistently recorded the highest pod yield ha⁻¹ in both locations this could be as a result of having higher pod yield per plant. *Tamarind* leaf powder consistently recorded higher pod yield ha⁻¹ than other plant botanicals in both locations. The control plot recorded lower pod yield ha⁻¹ in both locations. Lado *et al.* (2018) reported that basal application of *Parkia* fruit powder increased pod yield, pod length and number of cowpea grains pod⁻¹. The effectiveness of *Tamarind* leaf powder on *Alectra* control might explain the higher number of pods yield plant⁻¹ and per hectare. Hassan *et al.* (2016) highlighted the efficacy of *A. indica* leaf extract and *Polyacthia longifolia* for increasing groundnut pod yield. The interaction between variety and plant botanicals on pod yield ha⁻¹ was significant at Garko (Table 4). Pod yield of *Kwankwaso*, *Maibargo* and *Sabaiya* did not change with changing botanicals. However, treating *Samnut-24* with *Tamarind* leaf powder significantly increased pod yield compared with the control. *Sabaiya* treated with *Parkia* and *Azadirachta* fruit and leaf powders significantly showed significantly higher pod yield ha⁻¹ than the control and *Samnut-24* treated with *Azadirachta* leaf powder. Flavonoid and alkaloid in *Tamarind* leaf powder are compounds that are essential in reproduction, root nodule formation and biological nitrogen fixation; their presence explains higher pod yield ha⁻¹ and plant⁻¹ in plots treated with *Tamarind* leaf powder.

Table 3: Effect of Groundnut Varieties and Plant Botanicals on Pod Yield Plant⁻¹(g) and Pod Yield Hectare⁻¹(kg) at BUK and Garko

Treatments	Location			
	BUK	Garko		
	Pod yield per plant (g)	Pod yield per hectare (kg)	Pod yield per plant (g)	Pod yield per hectare (kg)
Variety (V)				
<i>Kwankwaso</i>	18.49	1466 ^c	19.14	1753 ^a
<i>Maibargo</i>	20.66	1661 ^b	17.23	1562 ^b
<i>Sabaiya</i>	23.56	1865 ^a	21.03	1892 ^a
Samnut – 24	19.03	1367 ^c	20.18	1403 ^b
Level of probability	0.096	< .001	0.155	< .001
SE _±	2.140	95.9	1.194	61.0
Plant botanicals (P)				
Azadirachta leaf powder	18.95 ^b	1509	19.71 ^{ab}	1703 ^{ab}
Tamarind leaf powder	27.82 ^a	2064	21.41 ^a	1772 ^a
Ficus spp. Leaf powder	18.85 ^b	1506	18.58 ^{ab}	1635 ^{ab}
Parkia fruit powder	18.65 ^b	1469	22.19 ^a	1678 ^{ab}
Control	17.70 ^b	1400	15.45 ^b	1473 ^b
Level of probability	< .001	< .001	0.009	0.045
SE _±	2.393	107.2	1.334	68.2
Interaction				
V x P	0.668	0.302	0.168	0.041

Means followed by the same letter(s) in the column are not significantly different at 5% level of probability using student- Newman keuls Test. Kg=kilogram, g=gram, %=percentage.

Table 4: Interaction of Groundnut Varieties and Plant Botanicals on Pod Yield Hectare⁻¹ (kg) at Garko

Plant botanicals	Groundnut Varieties			
	Kwankwaso	Maibargo	Sabaiya	Samnut-24
Azadirachtaleaf powder	1935 ^{ab}	1510 ^{abc}	2051 ^a	1316 ^{bc}
Tamarind leaf powder	1570 ^{abc}	1761 ^{ab}	1901 ^{ab}	1853 ^{ab}
Ficus spp. Leaf powder	1809 ^{ab}	1573 ^{abc}	1793 ^{ab}	1364 ^{abc}
Parkia fruit powder	1786 ^{ab}	1378 ^{abc}	2066 ^a	1483 ^{abc}
Control	1663 ^{ab}	1586 ^{abc}	1650 ^{ab}	993 ^c
SE _± 136.4				

Means followed by the same letter(s) in the column are not significantly different at 5% level of probability using student- Newman keuls Test.

CONCLUSION AND RECOMMENDATIONS

Based on the results obtained from this study, it can be concluded that treating sowing hole with plant botanicals significantly reduced the number of *A. vogelii* per stand and decreased its infestation level. This implies that there eventually will be depletion of *A. vogelii* seed bank since seed germination is reduced which in turn ensured control and reduced future infestation. The use of *Tamarind* leaf powder on *Sabaiya* in Sudan savanna of Nigeria is recommended for maximum *A. vogelii* control groundnut productivity. Further research with different rates of botanicals and methods for botanical application needs to be investigated. Furthermore, the genes responsible for resistance to the parasite in *Sabaiya* variety needs further attention.

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