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Comparative Efficacy of Four Botanical Extracts and Cypermethrin on Insect Pests of Cabbage (*Brassica oleraceae* Linn.)

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Abstract: Cabbage (*Brassica oleraceae* Linn.) is a very important vegetable crop grown worldwide. In Nigeria, it is cultivated by poor- resources farmers in Flood plains (Fadama) areas. Insect pests have been a major constraint to cabbage production. In an effort to find alternative control to synthetic insecticides, field experiment was conducted at Dadinkowa irrigation site located in Gombe State (10° 17' N and 11° 09' E) in early 2011 and 2012 dry seasons. The objective was to compare the efficacy of *Balanites aegyptiaca*Del., *Zingiber officinales* L.; *Allium sativum* L.; and *Aazadirachta indica* A. Juss aqueous extracts at 10% w/v concentration on cabbage insect pests. The experiment was laid out in a randomized complete block design with five treatments and a control. The results showed that *Z. officinales*, *A. sativum* and *A. indica* were effective in controlling cabbage insect pests than *B. aegyptiaca*. All the botanical extracts were at par with the standard check cypermethrin in controlling the insects. The four botanical extracts effectively controlled *Brevicoryne brasicae, Tricoplusia ni; Phyclotreta cruciferae*and *Phutella xylostella*. The botanical extractsalso prevented wrapper leaf and head damage; and improved cabbage growth and yield. Other indigenous botanicals should be tried in the area in order to get more alternative botanicals for controlling cabbage insect pests in the field.

Key words: Cabbage · Botanicals · Extracts · Cypamethrin · Control insect pests

INTRODUCTION

Cabbage (*Brassica oleraceae* L.) is one of the most important vegetable crop grown throughout the world [1, 2]. It is an excellent source of minerals, vitamins, foliates dietary fibre and medicinal properties [3]. In Nigeria, cabbage is grown by poor-resource farmers who utilize fadama (Flood plains) for producing the crop for domestic and commercial purposes.

The cultivation of cabbage in Gombe State is associated with several constraints including insect pests [4]. These insect pests include cabbage aphids (*Brevicoryne brassicae*), cabbage flea (*Phyllotreta cruciferae)*, cabbage looper (*Tricoplusia ni*), diamond back moth *Pluttella xylostella*), Cutworm (*Agrotis* sp.), cabbage borer (*Pieris rape)*, cabbage root maggot (*Delia radicum*) and cabbage Webworm *Crocidomia pavanona*) [5,6]. These insects can cause serious damage to young transplants and old plants. Damage to the head or wrapper leaves often reduces marketability of the cabbage; hence, there is the need to control insect pests of cabbage [7].

Management of insects is heavily dependent on the application of synthetic insecticides especially in Nigeria [8]. In Gombe State, synthetic insecticides like λ- cyhalothrin (Karate), deltamethrin (Decis) and cypermethrin (cymbush) have been recommended and encouraged by extension workers to vegetable farmers without considering some of their side effects [9]. Synthetic insecticides have been reported by several researchers and scientists to have some side effects such as human health hazards, environmental pollution, insects'resistance, pest resurgence, high cost and unavailability of the chemicals at critical periods of need [10].

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Inview of these side effects of synthetic insecticides, it is therefore necessary to try the use of botanicals as alternatives to synthetic insecticides that are effective, adoptable, easy to obtained and easy to use [11,12, 13].

The main objective of this is to attempt to find solutions to cabbage insect pests attack, reduce cost of cabbage production and protect both cabbage producers and consumers from the effects of chemical pesticides.

MATERIALS AND METHODS

Experimental Sites and Procedures: Field experiment was conducted at Dadinkowa irrigation sites located in Gombe State, Nigeria (10°' 17' N and 11° 09' E) with an average annual rainfall of 860 mm. It was conducted during early 2011 and 2012 dry seasons in a randomized complete block d esign using 5 treatments (ginger rhizome (*Zingiber officinales*); garlic bulb (*Allium sativum*); balanites leaves (*Balanites aegyptiaca*) neem leaves (*Azadirachta indica)*, a standard check (cypermethrin and untreated control replicated three times.

The experimental site was cleared of weeds and debris, ploughed, harrowed and ridged before transplanting cabbage seedlings. Each plot size was 4.0m by 3.0m with 1.0m interspaced and 2.0m border. Each plot had 5 rows with 5 plants/row making 25 plants/plot.

Collection and Preparation of Experimental Materials: The seeds of cabbage for the experiment was obtained from a reputable agrochemical dealer in Gombe main market, while ginger rhizomes, garlic bulbs and cypermethrin were purchased at Dadinkowa market. Fresh balanites leaves and neem leaves were collected at the premises of Upper Benue River Basin Authority (UBRBA) Office, Dadinkowa. Cypermethrin (cymbush 35% EC) manufactured by African agro-product limited was purchased from Gombe State Agricultural Development Programme (GSADP) farm inputs office Bogo, Gombe.

The preparation of all the botanical aqueous extracts were done using [14, 15] procedures to obtain 10% w/v concentration. The botanical extracts so obtained after preparation were stored in well labeled plastic bottles and kept in cool room.

Agronomic Practices: Cabbage seeds were initiallyplanted in nursery bed for 4 weeks in late rainy seasons of 2010 and 2011. The nursery bed was carefully watered until seedlings were ready for transplant in the experimental plots. During transplanting, the nursery bed was carefully watered before removing the seedlings with balls of earth to minimize damaged to the seedling roots. Transplanting was done during cool evening to prevent transplanting shock. The individual seedling was gently placed in the already prepared holes dug 2-3cm deep at a planting space of 45cm by 40cm apart.

Watering of the transplanted seedlings continued until they were fully established. Mix fertilizer NPK 15:15:15: was applied twice to the crop at 4 and 6 weeks after transplanting. Weeding was done as at when due using hand hoe.

Insecticide Application: From the botanical extract filtrates kept in plastic bottles, 100ml each of the solution wasadded with 1000ml of clean water to make 10% w/v concentration while cypermethrin was applied at 0.8litres/ha. The unsprayed control plots and cypermethrin were included in the treatments for the purpose of comparison.

The treatments were applied by spraying the cabbage plants late in the evening in order to reduce pesticides drift. Application started at 4 weeks after transplanting (WAT) and was repeated at 7 days interval using hand sprayer.

Data Collection: Data were collected on insect pest populations, plants height, wrapper leaves and head damage and yield.

Insect Pest Populations: Cabbage aphids (*B. brassicae*); cabbage looper (*T.ni*); cabbage flea beeth (*P.cruciferae*) populations were collected from ten randomly selected and tagged cabbage plants from each plot. The heads from tagged plants were dissected with sharp table knife and the larvae of diamond back moth (*P. xylostella*) were counted and recorded at harvest.

Plant height: cabbage plant heights were taken by measuring ten randomly selected and tagged cabbage plants from the base to the plants tip using meter rule in centimeters.

Wrapper Leaf Damage: Leaf damage data was obtained by counting the number of old and outer leaves showing chewed holes and with foliar removed tissues commencing from head formation till harvest.

Head Damage: Head damage data was obtained by counting and recording deformed and tunneled heads from the ten randomly selected and tagged cabbage plants at harvest.

Yield Data: Was obtained by harvesting both healthy and damaged heads from the tagged plots. The heads were then weighed, summed up and converted to hectares and recorded against each plot as yield data.

Data Analysis: Data collected over 2 years were then added together, divided by 2 and their means were subjected to analysis of variance (ANOVA). Significant means were compared and separated using least significant difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Cabbage plants sprayed with synthetic and botanical extracts had significantly lower insect pest populations when compared with untreated control plots (Table 1). *Azadirachta indica, Alium sativum* and *Zingiber officinales* aqueous extracts were more effective in controlling *P. crcuciferae, T. ni. B. brassicae* and *P. xylostella* than *B. aegyptiaca* treated plots. The efficacy of the three botanicals could be due to their strong pungent odour and repellent mode of action against the pests [16, 17, 7]. Reference [18] reported that botanicals are effective in deterring, repelling, inhibiting growth and restricting oviposition rate of major economically important pests. The effectiveness of the three botanicals proved hazardous to insect pests of crops and safer to beneficial and non-target insects after 7 days of their application [19]. These three botanicals were found to be at par with the cypermethrin, a synthetic insecticide used as a standard check.

The three botanical extracts were good as the synthetic used and significantly protected the cabbage from the insects, because neem contain azadirachtin, nimbin; garlic and ginger contains strong pungent odour, tripernoids, saponin glycoside, salanin, gallic acid as active ingredients [15]. Balanites was a poor botanical insecticide in terms of protecting cabbage from insect pests because it does not have a strong chemical component or active ingredient to repel, deter, restrict or inhibit growth, feeding and reproductive activities of the insect pests on cabbage [16]. This indicate that botanical can be as well as an attractive alternative to synthetic insecticide for insect pest control because most of them reputedly pose little or no threat to environment and to human lives [20, 17, 7]. Reference [17] reported that the active ingredients in *A. indica, A. sativum* and *Z. officinales* which are pungent make them very good botanical insecticides with repellent and deterrent mode of action against insect pest such as aphids, leafrollers, leafminers, leafbeetles and cabbage worms.

Cabbage plant heights were significantly higher in cypermethrin (13.62 cm); *A. indica* (13.09cm); *A. sativum* (13.12cm) and *Z. officinales* (13.09cm) treated plots than untreated control plots (8.13cm) (Table 2). The efficacy of the botanicals in controlling insect pests resulted in higher plant growth in the treated plots than the untreated since their leaves, stems and growing points were not affected by the feeding and boring activities of the insects which normally reduce the rate of photosynthesisof the plants. Moderate growth was recorded in *B. aegyptiaca* (11.37cm) treated plots while untreated plots had significantly lower plant height (8.13cm). Insect Pest feeding, rolling and chewing at the crowns and growing points of the young plants resulted in leaf defoliation and leaf damage. The feeding of these insect pests on floral stalks and buds had severely stunt cabbage growth [21]. Reference [22] reported that botanical insecticides can effectively control major insect pests of cabbage and thereby enhancing the plant growth. None control or late control of insect pests of cabbage will result to stunted growth, curling, wrinkling, cupping of leaves and yellowing, wilting and unmarketable heads of the crop especially when infestation is severe [23].

Table 3 show the results of leaf and head damaged/plot. Among the botanical extracts treated plots, *B. aegyptiaca* significantly had higher leaf (51.31) and head (6.40) damaged per plot while cypermethrin treated plots had lower leaf (40.32) and had (3.60) damage/plots.

There was no significantly difference among the botanical extracts treated plots. The untreated control plots had significantly maximum leaf (70.14) and head (11.33) damaged/plot. The non – significant leaf and head damage recorded among botanical extracts and synthetic insecticide (cypermethrin)indicate that the botanical aqueous extract used for this study and cypermetrin were at par with each other [22,8]. This lippies that both the botanical extracts and cypermethrin were effective in controlling cabbage insect pests in the field [24, 21, 6]. The damaged to wrapper leaves and heads were significantly reduced by the botanical extracts because many of these insect pests were either repelled or deterred by the botanical extracts active ingredients [27, 25,26]. The efficacies of the botanical extracts have reduced drastically the feeding of the cabbage aphids, cabbage looper, cabbage flea beetle and diamondback moth which usually affect the marketability of the wrapper leaves and head. Botanical extracts when applied on vegetables and other field crops at the correct formulations and intervals can be highly efficacious against lepidopterous pests than synthetic insecticides which most insect pests have developed resistance [8].

Table 1: Effect of botanical aqueous extracts and cypermethrin on cabbage insect Pest Populations after spraying Insect Pest Populations

Treatment	*P.cruciferae*	*T.ni*	*B.brassicae*	*P.xylostella*
Cypermethrin	1.21	0.00	0.01	0.45
Balanites aegyptiaca Leaves	3.40	3.02	4.10	2.87
Zingiber officinales rhizome	2.31	1.11	1.08	1.38
Allium sativum Bulb	1.30	0.87	0.73	1.28
Azadirachta indica Leaves	1.28	0.76	0.96	0.80
Control (untreated)	5.06	4.97	5.85	4.61
SE ±	0.13	0.18	0.09	0.24

Table 2: Effect of botanical insecticides and cypermethrin on cabbage plant growth after spraying

Treatment	Mean plant height (cm)
Cypermethrin	13.62
B. aegyptiaca	11.37
Z. officinales	13.09
A. sativum	13.12
A. indica	13.49
Control	8.13
SE ±	0.41

Table 3: Effect of botanical extracts and cypermethrin on leaf and head damaged cause by cabbage insect pests after spraying

Treatment	Mean leaf damaged/plot	Mean head damaged/plot
Cypermethrin	40.32	3.60
B. aegyptiaca	51.34	6.40
Z. officinales	41.10	4.33
A. satirum	40.89	4.16
A. indica	41.27	4.30
Control	70.14	11.33
SE ±	9.31	0.56

Table 4: Effect of botanical extracts and cypermethrin on yield of cabbage after spraying

Treatment	Mean Yield (Kg/ha)
Cypermethrin	0.53
B. aegyptiaca	0.42
Z. officinales	0.49
A. satirum	0.50
A. indica	0.52
Control	0.24
SE ±	0.18

Yield of cabbage were significantly different between treated anduntreated plots (Table 4). The yields were not significantly different among treated plots.

Cabbage plants sprayed with both botanical extracts and cypermethrin produced significantly higher yields than untreated plots. The higher yields obtained in treated plots were due to the effectiveness of the botanical extracts and cypermethrin in controlling cabbage insect pest attacks on the plants [25, 28]. Reference [7] reported that *Tephrosia vogelli; Lantana camara* and *Zingiber officinales* were effective against diamondback moth adult and larvae of cabbage and they produced the best yield. Botanical extracts apart from being effective against insect pests, they are safer and cheaper alternatives to synthetic insecticides [29, 30, 31, 28].

CONCLUSION

The present study showed that Neem leaves (*A. indica*); garlic bulb (*A. sativum*); ginger rhizome (*Z. officinales*) and balanites leaves (*B. aegyptiaca*) were effective in managing cabbage insect pests in the field. They were found to be at par with the standard check Cypermethrin. Their strong pungent odour, taste,

azadirachtin, nimbin, salanin, saponin-glycoside, garlic acid active ingredients served as anti -feedant, repellent and deterrent to the insect rests hence the reduction of the pest populations, improved plant height, leaf and head damage and increased head yields during the study period. It is recommended that other indigenous plant materials be tried in the area to get more alternative materials for cabbage insect pests control in the study area.

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