Journal of Research in Forestry, Wildlife & Environment Vol. 15(4) December, 2023
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http://www.ajol.info/index.php/jrfwe

ISBN: 2141 – 1778
Lawal et al., 2023

BIO-EFFICACY OF MINT LEAF EXTRACT (*Mentha pepirita*) FOR THE PROTECTION OF FIELD INSECT PEST OF SOYA BEAN (*Glycine max* (L.) *merr*) IN FEDERAL COLLEGE OF FORESTRY JOS

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ABSTRACT

Mint leaf extract has been shown to have insecticidal and antifungal properties that make it a promising natural alternative to synthetic pesticides for soyabean crops, there is limited research on its effects on the growth and yield of soyabean plants. This research work was conducted at the Federal College of Forestry, Jos student demonstration farm to determine the Bio-efficacy of mint leaf extract for the protection of insect pest of soyabean. A Randomised Complete Block Design (RCBD) comprising of four (4) treatment combinations (control, mint extract plus water, mint extract plus acetate, synthetic Cypermethrine) replicated four (4) times was used. Data were collected on plant height, leaf count, 100 seeds weight, and yield. The data was analyzed using ANOVA with Mini-Tab statistical package where significance was declared Turkey's method was used to separate the means. The result from the data collected shows that no significant difference of mint leaf extract was recorded on the plant height, and leaf count. However, significant difference was declared on the yield characters with T3 having the highest number of 100 seeds weight (26.17g), and yield recording (623.62 kg/ha). It can be concluded that mint leaf extract + acetate application produced the highest yield in soyabean and therefore be recommended to farmers for the protection of insect pest and optimum yield of the crop.

Keywords: Mint leaf, Soyabean, Protection, insect pest, Plant height and Yield

Correct Citation of this Publication
Lawal, I. H, *Ibrahim, Iro I., Yaroson, A. Y., Aminu, A. A., Dinchi, P. T, Hassan, I. A. Ubong, I. H., Ogenyi, R. A., Dogun, O. and Idris, J. A. (2023). bio-efficacy of mint leaf extract (*Mentha pepirita*) for the protection of field insect pest of soya bean (*Glycine max* (l.) *Merr*) in Federal College Of Forestry Jos. *Journal of Research in Forestry, Wildlife & Environment*, 15(4): 190 - 197

INTRODUCTION

Around 1100 BC, Chinese farmers brought soybeans from their native Southeast Asia and brought them under domestication (Bennett *et al*., 2014). The first reports of soybeans came from the United States (USA) in 1968, Japan in 1915, Korea in 1936, Machuria in 1938, and Korea in 1936. Since then, other regions of the world have adopted its cultivation. A total of 51.7 billion tons were produced on 37.6 million hectares. In 2007, global soyabean production reached over 216 million tons, of which roughly 20,000 tons were

exported from Africa (Transparency Market Research, 2018).

The arable crop soyabean (*Glycine max* L.) is characterized as an inexpensive source of protein, edible vegetable oil, and a well-balanced amino acid composition. The soyabean seed has a 20 percent oil content and a 34–36 percent protein content. According to Ajao *et al*. (2012), this factor establishes the soyabean seed's economic value. Its high protein content helps the poor farmer's families' nutritional health because, despite global agricultural advancements, the majority of people, primarily in Africa, remain severely undernourished (Otitoju and Avene, 2010). Since a nation that is malnourished would also be underproductive, having access to enough food and nutrition is essential for economic success. Malnutrition and poverty frequently plague the same oppressed population. The FAO's (2011) study on the rate of malnutrition and poverty found that while income eventually improves nutrition, the biggest nutritional issue Nigerians face now seems to be a lack of protein in their diet. This is a result of the high cost of the majority of animal protein sources, which makes it difficult for most people to consume enough of them. The average Nigerian is now aware that grain legumes may offer a less expensive source of protein due to the dramatic increase in the price of animal products (Otituju and Avene, 2010). Buckland *et al*. (2009) state that soybeans (Glycine max L.), a member of the pea family of leguminous vegetables, grow in tropical and temperate climates. Nigeria has increased its soy cultivation due to the crop's nutritional value, economic significance, and variety of domestic uses. While it can be planted as a single crop, planting it as a monocrop that can be broadcast or drilled yields the best results (Adebayo *et al*., 2018).

One of the most significant grains and legumes in the world, especially in Nigeria, is soybean. The crop's excellent nutritional content is well known. According to a previous analysis (FAO, 2011), soybeans have a higher protein content than any other crop, making up around 40% of the seed weight. Soybean is a plant-based source of protein, but it also contains a lot of the sulfur-containing amino acid lysine. Additionally, soybeans make up 20% of oil, and their products are a vital source of raw materials for the vegetable oil industry (ILDIS, 2005). When compared to other plant sources, soybeans have the highest ratio of protein utilization and efficacy across all leguminous crops (IART, 2019). Many insects find mint to be unpleasant, which deters them from visiting the plant they would otherwise spray.

Mint grows well adjacent to vegetable beds in rows or borders. However, interplanting vegetables that are growing in small groups rather than in a long row yields better results. This increases the perplexing or repulsive odor while decreasing the appealing food source. (Buckland and colleagues, 2009). The idea of "Crop Protection" against insect pests has drawn significant attention from all around the world. This is due to the fact that every significant country prioritizes food security. Researchers worldwide have implemented diverse techniques to safeguard crops from insect pests. (CABI, 2010). Using leaf extract to protect plants from insect pests is one of these techniques. These insects are generating significant losses and low yields in both the field and storage. feeding on stems, fruit, roots, and leaves or borrowing from them. Farmers have employed synthetic pesticides, but these are frequently pricy, hard to find, and have persistent effects. This research project aims to close this gap by evaluating the bioefficacy of mint leaf extract in controlling field insect pests that affect soy beans.

MATERIALS AND METHODS

The study was carried out at the Federal College of Forestry, Jos students' demonstration farm. The College is located in Jos North Local Government Area of Plateau State, between latitude 9°94' North and 9°56' North and longitude 8°89' East and 8°53' east with an elevation of 1,200 m above sea level. It has a climate generally of tropical humid with annual rainfall of about 14600 – 14800 mm and approximate annual temperature of 10^0-32^0C minimum and maximum (Dafwang, 1990). It contains well drained and aerated sandy loam soil.

Source of Materials and Preparation

The soyabean seeds were sourced from Plateau Agricultural development programme (PADP). Mint leaves was collected from the department of Horticulture, Federal College of Forestry, Jos Spice garden. The leaves were cleaned washed with tap water and rinse with distilled water. It was put under shade to dry. The sample were grounded to powder using pestle and mortar.100g of the sample (Mint leaf powder). Extraction was done at the chemistry laboratory, Federal College of Forestry, Jos. The Mint leaf powder is placed inside a thimble. The thimble was loaded in the main chamber. The extraction solvent (ethanol) was placed in a distillation flask. The flask was then placed on a heating element. The solvent is heated to reflux and its boiled, the vapour travels upward through the extraction tube into the condenser tube cool water flows from the inlet to outlet (this is to cool in the condenser) so that condensation can take places. The condenser tube condensed the vapour which than drips into the thimble containing the sample. Some of the desired compound dissolved in the warm solvent. When the soxhlet chamber is almost full the chamber is emptied by the siphon the solvent is retained back to the distillation flask. The thimble ensures that the rapid motion of the solvent does not transport any solid material to the pot. This cycle is allowed to repeat many time over hours or day and in each cycle a portion of the non-volatile compound dissolved into the solvent. After many cycles the solvent is removed typically by means of rotary evaporation.

Soil Analysis

Soil sample was collected at two different depths (0 -15 cm and 15 – 30 cm) using soil auger and hand trowel, the sample was dried at room temperature and was taken to Agricultural Services and Training Center (ASTC) Kassa for analysis.

Agronomic Practices

Land preparation was done by measuring the land area using a measuring tape and cleared to remove any form of debris using small hoe and cutlass, marking out was done also with the use of measuring tape and rope. Beds of 2m x 2m were made and a discard of 0.6m ridges were made on the bed on which the seeds were planted. The seed was sown on the field and 2 seed per hole at a spacing at 60 cm x 15 cm to a depth of 2cm. Fertilizer application was done within the second week of planting 200g of NPK 15: 15:15 was applied per plot.

Treatments and Experimental Design

The experiment was carried out using randomize complete block design (RCBD). There were four (4) treatments in the experiment namely Control (T1), Mint Extracts + water (T2), Mint Extract + Acetate (T3) and synthetic (Cypermethrine) (T4). Each treatment was replicated four times. The prepared extracts were applied three (3) times. First application of was carried out during vegetative stage, the second during flowering and the third during podding. Bottle like sprayer was used in spraying the extract to the plants.

Data Collection and Analysis

Ten (10) plants was randomly selected and tagged from each replicate and was used for data collection. The data collected include: - Plant Height: This was measured from the base to the tip of the plant using, a meter rule in centimeter (cm). Leaf Count: This was done by counting the number of leaf in the tagged plants. 100 seed Weight: This was done by counting 100 seeds and using a weighing balance to determine the weight in kilogram (kg). Total yield: This was calculated in kilogram kg/ha^{-1}.

Data collected was analyzed using analysis of variant (ANOVA) and means with significance difference was separated using Minitab statistical package, turkey methods of Miritab statistical packages at 5% level of probability.

RESULTS

Phyto-chemical tests for the extracts were performed and the result from Table 1showed that Tanins, Flavanoids, Alkaloids, Phenols, Coumarines, Proteins and Amino-acids, Terpenoids, Steroids and Batacynins are present in Ethyl acetate while Saponnins, Anthocyanins, Glycosids, Acids, Phlobatannins, and Anthoquinones were absent. Where as in Ethanol, Tannins, Flavaniods, Phenols, Coumarines, Proteins and Amino-acids, Anthoquinones, Terpenoids, Steroids and Batacynins are present are all present and those

absent include Saponnins, Alkaloids, Anthocyanins, Glycosids, Acids and Phlobatannins. Similarly, minth extract in water was found to contain the following, Tannins, Flavanoids, Alkaloids, Phenols, Coumarines, Proteins and Amino acids, Terpenoids, Steroids and Batacynins with Saponnins, Anthocyanins, Glycosids, Acids, Phlobatannins, and Anthoquinones absent.

Table 1: Phyto-chemical Analysis of Mint Leaf

S/No.	Phytochemical Screening	Ethyi Acetate	Ethanol	Water
1	Tannins	+	+	+
2	Saponnins	-	-	-
3	Flavanoids	+	+	+
4	Alkaloids	+	-	+
5	Anthocyanins	-	-	-
6	Glycosids	-	-	-
7	Phenols	+	+	+
8	Coumarins	+	+	+
9	Acids	-	-	-
10	Proteins And Amino Acid	+	+	+
11	Phlobatannins	-	-	-
12	Anthoquinone	-	+	-
13	Terpenoids	+	+	+
14	Steroids	+	+	+
15	Batacyanins	+	+	+

Source: Chemistry Laboratory, Federal College of Forestry, Jos

Bio - Efficacy of Mint Leaf Extract on the Plant Height of Soybean

The bio-efficacy of mint leaf extract on the plant height of soya bean is presented in the Table 2. The result indicates that at 2 Weeks After Planting (WAP), mint leaf extract did not significantly influence the plant height of soya bean. However, mint extract plus acetate (T_3) recorded the highest plant height of 5.80 cm, closely followed by T_2 (5.67 cm), then T_4 (5.4 cm) and T_1 (5.17 cm) respectively. At 4 WAP, (T_2) mint extract plus water recorded, the highest plant height (12.10 cm) as against the other mint application with T_1 producing the shortest (1.42 cm) plant. The result at 6WAP reveals that mint extract plus water (T_2) recorded, the highest plant height of (75.25 cm) while (T_1) control recorded the lowest soya bean plant height. At 8WAP, 10WAP and 12WAP, mint extract plus acetate (T_3) recorded the highest plant height of (19.15 cm), (19.40 cm), (19.65 cm) respectively. The combined mean plant height of soya bean indicates the highest plant height of 15.64cm was measured for T_2 and the least at T_4. At the end of the treatments no significant difference was observed between the treatments on the plant height of soya bean.

Table 2: Bio - Efficacy of Mint Leaf Extract on the Plant Height of Soybean

Treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12 WAP	MEAN
T1	5.17	10.42	15.40	18.22	18.55	18.82	14.60
T2	5.67	12.10	17.25	18.97	19.67	20.17	15.64
T3	5.80	12.07	17.15	19.15	19.40	19.65	15.62
T4.	5.40	11.55	17.05	18.60	19.07	19.27	15.48
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS

Means that do not share a letter are significantly different, NS = Not significant at p> 0.05, T1 = Control, T2 = 0.4mls (mint extract plus water), T3 = 0.4mls (mint extract plus acetate), T4 = 0.4mls (Cypermethrin), LSD = least significant difference.

Bio - Efficacy of Mint Leaf Extract on the Leaf Count of Soybean

The bio-efficacy of mint leaf extract on the leaf count of soya beans is presented in table 3. The result show that at 2WAP no significant effect of mint leaf extract plus acetate, recorded the highest number of leaf count of (8.20). While (T_4) synthetic (Cypermethrin) recorded the lowest values of (7.55). at 4WAP, T_4 synthetic (Cypermethrin) recorded the highest leaf count of (23.67). While T_1 has the lowest value of leaf count of (17.70). The result at 6WAP shows that T_4 recorded the highest number of leaf count of (47.97). while T_1 has the lowest number of leaf count with the value of (38.55). At 8WAP T2 mint extract plus water recorded the highest number of leaf count of (17.45), While T_1 control has the lowest value of (67.05). Also at 10WAP and 12WAP T_2 mint extract plus water has (78.02) and (75.87) recorded the highest number of leaf count of soya bean plant.

The mean leaf count of the soya bean plant indicates that (T_2) mint extract plus water gave the highest number of leaf count of (48.60) although there were no significant differences between the treatments on the number of leaf count of soya beans

Table 3: Bio - Efficacy of Mint Leaf Extract on the Leaf Count of Soybean

Treatment	2WAP	4WAP	6WAP	8WAP	10WAP	12WAP	MEAN
T1	7.62	17.70	38.55	67.05	67.97	.69.05	44.65
T2	7.82	18.47	44.97	71.45	73.02	75.87	48.60
T3	8.20	20.47	45.22	67.15	68.90	70.40	46.72
T4	7.55	23.67	47.97	69.62	72.05	73.72	49.10
LSD(0.05)	NS	NS	NS	NS	NS	NS	NS

Means that do not share a letter are significantly different, NS = Not significant at p> 0.05, T1 = Control, T2 = 0.4mls (mint extract plus water), T3 = 0.4mls (mint extract plus acetate), T4 = 0.4mls (Cypermethrin), LSD = least significant difference.

100 Seed Weight (g)

Bio-efficacy of mint leaf extract on 100 seed weight of soya beans is presented in Table 4. The result shows that T_3, mint extract plus acetate recorded the highest (100 seed weight) of soya bean of (26.17 g) and T_2 mint extract plus water recorded (25.37 g) seed weight and T_4 synthetic (cypermethrin) has the value of (23.15 g) and (T_1) that is control recorded the lowest seed weight with the value of (22.60 g) respectively.

Yield (kg/ha)

Similarly, Table 4 shows that, the application of mint extract plus acetate (T_3) recorded the highest yield (623.62 kg/ha) followed by (T_2) mint extract plus water having (531.37 kg/ha). Also (T_4) synthetic Cypermethrine recorded (520.75 kg/ha). and (T_3) which is control recorded the lowest value of (468.75 kg/ha) yield respectively. The result shows that, there was significant difference at ($P \leq 0.05$) of mint leaf extract on the yield of soya bean.

Table 4: Bio- Efficacy of Mint Leaf Extract on 100 Seeds Weight (kg) Yield (kg/ha) of Soyabean

Treatment	100 Seeds Weight (g)	Yield (kg/ha)
T1	22.60^{b}	468.75^{b}
T2	25.37^{a}	531.37^{ab}
T3	26.17^{3}	623.62^{a}
T4	23.15^{b}	520.75^{ab}
LSD(0.05)	***	*

*Means that do not share a letter are significantly different, * = Significant at p < 0.05, *** = Significant at p < 0.001*

DISCUSSION

While mint leaf extract has been shown to have insecticidal and antifungal properties that make it a promising natural alternative to synthetic pesticides for soybean crops, there is limited research on its effects on the growth and yield of soybean plants.

Soybean is one of the most important crops worldwide, providing a significant source of protein and oil for humans and animals. However, it is susceptible to various insect pests, which can cause significant yield losses. The use of chemical insecticides is a common practice for controlling these pests. Still, it has several environmental and health hazards. Therefore, there is a growing interest in exploring natural plant-based alternatives to synthetic pesticides.

Mint leaves have been used for centuries for their medicinal properties, and recent research has shown that they possess insecticidal properties as well. According to Zekri *et al*. (2016), the active compounds in mint leaves have been reported to have insecticidal effects on various insect pests. These compounds act as neurotoxins by disrupting the nervous system of insects, leading to paralysis and death. Several studies have been conducted to evaluate the bio-efficacy of mint leaf extract for the protection of soybean crops against insect pests. Ikbal and Pavela (2019) reported that the application of mint leaf extract significantly reduced the population of soybean pod borer (Helicoverpa armigera) and soybean aphid (Aphis glycines). The researchers found that the mint leaf extract had a dose-dependent effect on the pest population, with higher concentrations resulting in greater mortality. The application of mint leaf extract significantly reduced the population of soybean thrips compared to the control group (Gharbi, 2022). He also found that the mint leaf extract had no adverse effects on non-target insects, indicating its selective toxicity towards the target pest.

In addition to its insecticidal properties, mint leaf extract has several other benefits for soybean crops. It has been reported to have antifungal properties, which can help protect soybean plants from fungal diseases. Mint leaf extract also has a repellent effect on some insect pests, which can help prevent infestations in the first place (Buatone and Indrapichate, 2011).

This research work was carried out to determine the efficacy of leaf extract for the protection of soya beans in FCF Jos. The major findings from the work reveals that no significant different of mint leaf extract was observed on insect pest of soya bean for plant height, stem girth, number of branches, leaf count and leaf area. This implies that the growth characteristics of soya beans was not in any way affected by mint leaf extract. This finding contrasts with that of Chalkos *et al*. (2010), who found that adding mint to growth media at different rates (0–8% w/w) greatly enhanced tomato growth while simultaneously preventing the establishment of weeds. Argyropoules *et al*. (2008) also stated that, despite the good benefits of *Mentha pepirita* compost on weed management, its negative effect on plant growth and yield has been identified. When an intercropping system was used, Ulbrich *et al*. (2018) reported that *menthe pepirita* essential oils had stimulatory effects on *Brassica oleraceae* seedlings. However, they also highlighted that no effect was seen when pure compounds were applied. To determine if the combined action of volatile components or other substances secreted from mint plants is responsible for the allopathic activity, these findings require additional research.

A study conducted to evaluated the effect of mint leaf extract on the growth and yield of soybean plants by Karkanis *et al*. (2019), found that the application of mint leaf extract had a positive effect on plant growth and yield. The extract was applied as a foliar spray at different concentrations, and the results showed that the highest concentration of mint leaf extract (10%) had the most significant effect on plant height, number of branches, and number of pods per plant. The yield of soybean pods was also increased by 10% compared to the control group. However, it is important to note that higher concentrations may not always be better, as they can lead to phytotoxicity or damage to the plant. Therefore, it is crucial to determine the optimal concentration of mint leaf extract for each specific crop and environmental condition.

Similarly, the application of mint leaf extract significantly improved plant growth and yield under water stress conditions. The extract was applied as a soil drench at different concentrations, and the highest concentration (5%) had the most significant effect on plant height, number of branches, and yield of soybean pods (Parrey *et al*., 2023).

CONCLUSION AND RECOMMENDATION

The result from this research work shows that no significant difference of mint leaf extract was observed on plant height, and leaf count. However, there were significant difference with T3 mint extract plus acetate 69.25, producing 100 seeds weight (g) 26.17 g. The yield (kg/ha) was significantly affected by the application of mint extract plus acetate with T3 having the highest yield of 623 kg/ha. It can be concluded that Mint leaf extract has no significant difference for the protection of soyabean plant against insect pest on the growth characteristics of soyabean. Mint leaf extract application for the protection of insect pest of soyabean significantly affected the yield and yield characteristics of soyabean. The most effective treatment for the protection of insect pest of soyabean is T3 mint extract plus acetate. while the studies mentioned above suggest that mint leaf extract can positively impact the growth and yield of soybean crops, further research is needed to determine the optimal concentration and application method and to evaluate the long-term effects on soil health and the environment. Nevertheless, the potential of mint leaf extract as a natural alternative to synthetic pesticides is promising, and it may provide a sustainable and safer solution for soybean crop protection and growth.

Acknowledgements

I wish to express my profound gratitude to Almighty God for his abundant blessings and Marcy throughout the period of these research work, my special gratitude also goes to my Colleagues, Mr. Ibrahim Iro Ibrahim, Yaroson A.Y., Aminu A. A, Dinchi, P. T, Hassan, I. A. and Ubong, Ime Henry for their contribution, corrections, throughout the time of research work which leads to the completion of the work despite tight schedule.

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