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Original article

Impact of Neem (*Azadirachta indica*) leaf extract on the management of whitefly in the tomato crop

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Abstract
The study was conducted in the Higher Institute of Agricultural Techniques, Derna, Al-Fattayah, in the city of Derna, Libya. A positive impact of the treatment is evident. There are distinct morphological differences between the treatments, with the treated plants achieving the highest mean values for the number of inflorescences per lateral, the number of branches per plant, and fruit weight. The results showed that the number of branches in the treated plants averaged 7, compared to 6 branches in the control group. Regarding the number of inflorescences, the treated plants recorded an average of 14 inflorescences per branch, while the control group averaged 11 inflorescences per branch. Statistical analysis comparing the means reveals that the average fruit weight of the treated plants was 135.95 g, compared to 116.40 g for the control. Additionally, another difference was noted in the lateral growth of the canopy; the treated plants recorded an average width of 103.68 cm, while the control plants recorded an average width of 85.16 cm.
Keywords. Inflorescences, Morphological, Treatments.

Introduction

Neem (*Azadirachta indica*), the large tree of India, has been used in our country and all over the world as an anti-fungal, insecticide, and nematicide, and for many other medicinal uses, and it is also used as medicine in Ayurveda. And every part of the tree has different types of uses [1]. Some extracts of the neem plant are toxic to fungal pathogens such as Aspergillus flavus from soya bean seeds. *Azadirachta indica* is popularly known as the Indian neem or margosa tree. It's been extensively used in ayurveda, unani cand homoeopathic medicine since time immemorial. In Sanskrit, a "good health" condition is expressed as "Nimba[2], which, on due time derived into "Neem", further the tree is considered as "*Sarvaroga nivarini*" means cure all ailments. In Ayurveda, neem is known as "*Arishtha*" meaning 'reliever of sickness'. The tree is still regarded as "village pharmacy" or "Divine tree" due to the presence of medicinal properties in India [3].

Azadirachta indica, a member of the Meliaceae family, is commonly known as neem and has long been recognized for its medicinal properties. It grows in tropical and semi-tropical regions of the world, and the different parts of this tree, such as seeds, leaves, flowers, and bark, are widely used for different purposes. Different phytochemicals, such as quercetin, azadirachtin, and liminoids such as nimbin, nimbinin, and nimbidin, have been purified from the different parts of the plant. Moreover, the leaves also contain a mixture of compounds such as nimbanene, 6-desacetylnimbinene, nimbandiol, nimbolide, ascorbic acid, n-hexacosanol, nimbiol, various amino acids, and several other types of ingredients.[4]. Neem tree extracts have been extensively used in health management since ancient times and have a variety of health-promoting properties[5]. Pyricularia oryzae in rice crops [6]. Neem extracts are also used as insectcide which avoids the disease incidence by insects [7].

The chemistry of Neem consists of several thousand chemical compounds present in Neem. The most well-known constituent of neem is *Azadirachtin*. It is called terpenoids. These neem terpenoids are present all over the Neem plant. Along with this they are 20 Sulphur compounds present in the Neem oil, which are responsible for the characteristic smell of Neem oil and crushed seeds. Neem botanical classification Azadirachta indica A. Juss., widely referred to as the neem tree, belongs to the family *Meliaceae* within the kingdom *Plantae*. It is classified under the order *Sapindales* and the genus *Azadirachta*. The species designation *indica* reflects its origin and distribution across the Indian subcontinent and other tropical regions. Neem is recognized for its ecological, medicinal, and agricultural significance, with extensive studies highlighting its bioactive compounds, such as azadirachtin, which exhibit pesticidal, antimicrobial, and therapeutic properties. Its taxonomic placement within *Meliaceae* situates it among other economically important trees, underscoring its relevance in both botanical research and applied sciences.

Among the many insects that feed on the tomato plant, the most important is whitefly, Bemisia tabaci. While feeding on tomato plants, whitefly infects them with viruses, e.g., begomoviruses (family Geminiviridae, genus Begomovirus), which often limits the cultivation of crops [8]. Cover cropping with polypropylene mesh has been introduced to avoid contact between the plant and whitefly in the early stages of development, resulting in high yields with good fruit quality. Corn root worm Diabrotica spp. is another pest that feeds on tomato plants [9]. The larvae develop in soil feeding on roots, while the adults eat leaves, flowers, buds, and pods, seriously damaging the plant. The study was conducted in the Higher Institute of Agricultural Techniques, Derna, Al-Fattayah, in the city of Derna, Libya.

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Materials and Methods

Experiment site

Higher Institute of Agricultural Techniques, Derna, Al-Fattayah, in the city of Derna, Libya (Figure 1).

Figure 1. Study site

Leaf extract preparation

Neem trees were selected randomly. Five hundred grams of leaves were sampled from each tree. Fresh leaves were washed with water to clean them, cut into 2mm² squares, added to five liters of water, left in the dark for 48 hr, which was sufficient to extract most of the active components of neem. Extraction procedures were kept as simple as possible to be easily applicable for local farmers.

Cultivation of the tomato plant and application of the leaf extracts of neem

The field experiment (In vivo) was conducted from May to August 2023. The study followed a Randomized Complete Block Design (RCBD) with four blocks, each containing 25 plants, totaling 100 plants divided into one control group and three treatment blocks. The treatment, consisting of undiluted pure neem leaf aqueous extract, was applied weekly for a total of three foliar sprays during the seedling stage. Measurements were taken for the length and width of vegetative growth, the number of branches, and the number of flowers per branch. Following the harvest, the fruits were counted and weighed.

Results and Discussion

According to the results presented in Figure 2, a positive impact of the treatment is evident. There are distinct morphological differences between the treatments, with the treated plants achieving the highest mean values for the number of inflorescences per lateral, the number of branches per plant, and fruit weight.

Figure 2. Morphological differences

reported the greatest improvement in tomato plant growth in neem-cake amended soil. Amrendra et al. (1997) also reported that the effects of different combinations of 10 organic amendments and 3 chemicals on the growth and yield of tomato (Lycopersicon esculentum Mill.) were studied and results showed that the plant height, girth, leaf/plant, branch/plant and spread of tomato were significantly increased by the combination of 10 organic amendments and 3 chemicals. Results represented by Kumaran et al. The results showed that the number of branches in the treated plants averaged 7, compared to 6 branches in the control group. Regarding the number of inflorescences, the treated plants recorded an average of 14 inflorescences per branch, while the control group averaged 11 inflorescences per branch. Similarly, the fruit weight for

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the treated plants was 183.60, whereas the fruit weight for the control was 164.5 (Figure 3). Applying leaf extracts of G. sepium to tomato plants increased their development, especially the dry and fresh weight. It is difficult to speculate what might have caused this, but different explanations are possible. First, the leaf extracts of G. sepium reduced the number of insects and worked as a repellent, so the damage to plants was smaller, and they could develop better. However, this treatment was not a better repellent than leaf extracts of neem or chemical insecticides. Second, extracts of other plants, like eucalyptus (Eucalyptus chamadulnosis (Dehnh)), garlic (Allium sativum), marigold (Tagetes erecta), and neem have nematicidal effect on juveniles of nematode, Meloidogyne incognita [10].

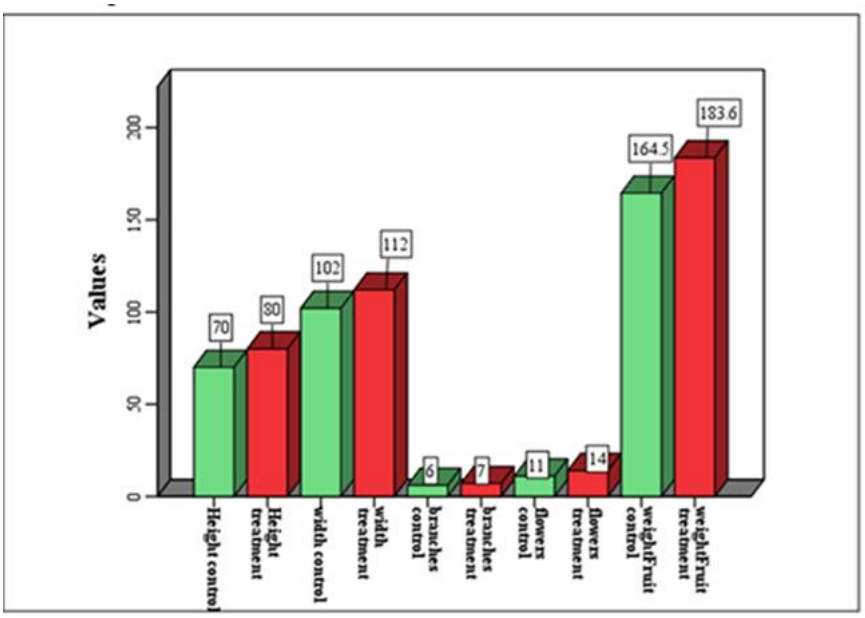

Figure 3. Fruit weight for the treated plants

Statistical analysis revealed no significant differences among the other treatments (LSD), $P < 0.05$), F-values). In terms of comparing the means, it is observed that the average fruit weight of the treated plants was 135.95 g, compared to 116.40 g for the control. Additionally, another difference was noted in the lateral growth of the canopy; the treated plants recorded an average width of 103.68 cm, while the control plants recorded an average width of 85.16 cm (Table 1).

Table 1. Effect of neem products on tomato seedlings

Variables		Mean	Std. Error
Height	Control	60.60	± 1.23
	Treatment	69.80	± 1.39
Width	Control	85.16	± 2.19
	Treatment	103.68	± 1.93
Branches	Control	4.72	± 0.16
	Treatment	5.80	± 0.20
Flowers	Control	8.76	± 0.20
	Treatment	9.80	± 0.36
Weight Fruit	Control	116.40	± 5.42
	Treatment	135.95	± 6.17

Conclusion

The proposed research directions highlight a comprehensive strategy for advancing plant-based therapeutic applications. First, the investigation of other indigenous plant species is essential to broaden the scope of biological activity studies and to identify novel compounds that can serve as effective alternatives in combating diverse plant diseases. Second, the adoption of modern purification techniques is critical for enhancing the isolation and refinement of bioactive compounds from plant extracts, thereby ensuring greater precision, reproducibility, and efficacy in subsequent applications. Finally, synergy studies involving mixtures of crude extracts represent a promising approach to uncovering potential combined effects against various microorganisms, which may lead to more potent and sustainable solutions than those achieved through single-extract treatments. This integrated framework underscores the importance of combining

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traditional knowledge with modern methodologies to maximize the therapeutic potential of local plant resources.

Conflict of interest. Nil

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