Effect of foliar application of some plant extracts (fenugreek seed soak and neem leaf extract) on the vegetative and floral growth and bulb yield of narcissus (*narcissus* spp.)

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Abstract:

This experiment has been carried out in autumn season 2024\2025 in a plastic greenhouse at Research Station B of Department of Horticulture and Landscape Engineering of the College of Agricultural Engineering Sciences, University of Baghdad. The purpose of this experiment was to determine the effect of two naturally derived plant extracts, fenugreek seed soak (*Trigonella foenum-graecum*) and leaf extract of neem (*Azadirachta indica*) on vegetative growth, flowering and bulb yield of *Narcissus* spp. under protected cultivation conditions. The experiment conducted as factorial arrangement in a randomized complete block design (RCBD) with two factors: the first factor was foliar application of fenugreek seed soak at three levels of concentration (0, 5, and 10 g L^{-1}) and the second factor was neem leaf extract at three levels of concentration (0, 5, and 10 g L^{-1}). The results indicated that neem leaf extract significantly enhanced most vegetative, floral, and bulb yield traits. The treatment with 10 g L^{-1} neem extract (N2) resulted in the tallest plants (54.44 cm), the highest number of leaves (9.78 leaves $plant^{-1}$), the greatest chlorophyll content (53.20 SPAD units), and increased both fresh and dry weights of the vegetative parts (93.0 g and 54.40 g, respectively). Furthermore, it exhibited significant superiority in flowering characteristics, including the number of flowers (9.78 flowers per plant), flower diameter (9.206 centimeters), flower stalk length (45.81 centimeters), and flowering duration (8.111 days). Bulb characteristics such as bulb number (1.67 bulbs per plant) and bulb weight (45.19 grams) were also superior. Meanwhile, the fenugreek seed soak contributed to improvements in most vegetative and floral growth parameters. The treatment H_2 (10 g L^{-1} fenugreek extract) showed increased plant height, number of leaves (8.67 leaves per plant), leaf chlorophyll content (52.78 SPAD), and fresh and dry weights of the vegetative parts (88.72 g and 50.08 g, respectively). In terms of floral traits, this treatment enhanced the number of flowers per plant (7.33 flowers), flower diameter (7.634 cm), scape length (43.32 cm), and flowering duration (7.333 days). It also performed better in bulb-related traits such as number of bulbs per plant (1.22 bulbs) and average bulb weight (40.65 g).). The interaction between the two factors showed clear superiority in some vegetative traits, with the H2N2 treatment being distinguished by increased vegetative and floral traits and bulb yield.

Keywords: Bulbs, neem extract, fenugreek extract, Narcissus

Introduction

Narcissus an important ornamental plant grown for the beauty of their flowers and the variety of their cultivars (3). *Narcissus gazette* L. belongs to the Amaryllidaceae family. Narcissus is distinguished by its international cut specifications in terms of its attractive flower colors, the length of the flower stalk, and the large diameter of its flowers.

Narcissus propagated by seeds, which take 2-3 years to germinate and flower to form. The best method for propagation is through bulbs that are 100% identical to the parent plant (4). Given the increasing demand for high-quality plant production, research has turned to using natural methods such as plant extracts to improve growth and productivity in an environmentally friendly and safe manner for humans and animals. Among these extracts, fenugreek extract is known for its richness in active substances and phytohormones, while neem leaf extract is characterized by its antimicrobial and stimulant properties.

Plant extracts are environmentally friendly bio-alternatives commonly used for plant growth promoters (11), susceptible resistance in plants against diseases and unfavorable environmental condition. These active ingredients are then derived from the plant (leaves, seeds, barks or roots) using a solvent like water/alcohol. (9) Several organic compounds e.g., Phenols, alkaloids, terpenes, flavonoids etc. are present in plant extracts which are having growth promoting (or) antimicrobial properties (1, 8).

Of these plant extracts, neem leaf extract (*Azadirachta indica*) is one of the most significant botanical extracts used in agriculture (13). This is mainly attributable to the presence of its active component, azadirachtin that has strong insect growth inhibition activity and biological antagonism (15). Neem extract besides its pesticidal activity also been reported to have potential for improving vegetative growth and contentment of chlorophyll content (6).

Fenugreek (*Trigonella foenum-graecum*) as described by Siddiqui et al., (16), is a source of growth stimulants amino acids, plant steroids, and saponins. It has been shown in many studies to increase seed germination and enhance both vegetative and floral growth on a wide range of crops. It is also involved in plant tolerance to a variety of environmental stresses.

Plant extracts are generally applied in different concentrations and are directly sprayed onto the plant leaves or may be incorporated into the soil. This capacity would have an important s potential in the improvement of vegetative and floral traits, turning them as promising alternative to be used in sustainable agricultural systems.

Research Objectives

1- the effect of some plant extracts (fenugreek seed infusion and neem leaf extract) on the growth, flowering, and bulb yield of *Narcissus tazetta*., variety Triandrus Daffodils.

2-To investigate the impact of fenugreek seed soak on the vegetative and floral development and bulb yield of daffodil plants.

3-To determine the interactive effect between neem and fenugreek extracts on the studied traits.

Materials and Methods

The experiment was conducted in the greenhouse of the Department of Horticulture, College of Agricultural Engineering Sciences, at Research Station B for the academic in autumn season 2024-2025. The experiment was conducted to determine the effect of some plant extracts (fenugreek seed infusion and neem leaf extract) on the growth, flowering, and bulb yield of *Narcissus tazetta*. The soil was prepared for planting by plowing and leveling it, and raised beds were created for the Narcissus bulbs and irrigation pipes were installed. Narcissus bulbs were planted at a depth of 7–8 cm, depending on their size. Bulbs were sourced from a private distributor in the Kurdistan Region, while the plant materials used for extract preparation were obtained from local markets. The plant extracts were prepared by finely grinding the materials and soaking them in water (1 liter) according to their respective concentrations at room temperature for 24 hours. The solutions were then filtered and prepared for foliar application, with a few drops of dish soap added to enhance spray coverage by reducing surface tension.

The experimental design included two factors:

1. Foliar application of fenugreek seed infusion at concentrations of 0, 5, and 10 g L^{-1}
2. Foliar application of neem leaf extract at concentrations of 0, 5, and 10 g·L^{-1}

Treatments were applied early in the morning starting 30 days after planting or once the fourth true leaf had emerged, continuing until full foliar wetting was achieved

The experiment was laid out using a Randomized Complete Block Design (RCBD) in a 3 × 3 factorial arrangement with three replications, totaling 3 × 3 × 3 experimental units. Each treatment involved four plants, resulting in 108 experimental plants in total. Spraying was conducted three times: once a month after planting, before flowering, and a final time after flower harvest to stimulate bulb development.

Results and discussion

Vegetative Growth Indicators

The results in Table 1 showed significant differences among the studied treatments. The treatment (N2), which involved spraying with neem leaf extract, significantly outperformed in most vegetative growth traits, with plant height reaching (54.44 cm), number of leaves (9.78 leaves/plant), leaf chlorophyll content (53.2 SPAD), and fresh and dry weights of vegetative growth (88.72 g and 55.18 g, respectively), compared to the control treatment, which recorded the lowest values of (44.56 cm, 6.11 leaves $plant^{-1}$, 41.11 SPAD, 69.30 g, and 46.78 g, respectively).

The results also reveals a statistically significant improvement due to foliar application of fenugreek seed soak. Among these treatments, H_2 (10 g L^{-1} fenugreek extract) showed the most pronounced enhancement in most of the vegetative growth parameters studied. This included plant height (52.78 cm), leaf number (8.67 leaves per plant), leaf chlorophyll content (50.08 Spad units), fresh weight (88.72 g), and dry weight (55.18 g). These values were higher than those of the control plants, which recorded 43.89 cm for plant height, 6.56 leaves per plant, 43.52 Spad units for

chlorophyll content, 78.88 g (fresh weight), and 48.46 g (dry weight), respectively.

The interaction treatment had a significant effect on some of the studied traits. The interaction treatment between the two studied factors (N2H2) showed clear significant superiority in the number of leaves (10.33 leaves plant^{-1}) and leaf chlorophyll content (55.35 SPAD), compared to the control treatment, which gave the lowest values (4.67 leaves/plant and 37.77 SPAD). However, no significant superiority was observed in plant height or fresh and dry weights.

Table 2. Effect of Foliar Application of Plant Extracts (Neem Leaf Extract and Fenugreek Seed Infusion) on Vegetative Growth of Narcissus Plants

Dry Weight of Vegetative Growth (g)	Fresh Weight of Vegetative Growth (g)	Leaf Chlorophyll Content (SPAD)	Number of Leaves (leaves plant^{-1})	Plant Height (cm)	Treatments	
N						
46.78	69.30	41.11	6.11	44.56	N0	
53.04	84.69	45.81	7.22	46.89	N1	
54.40	93.90	53.2	9.78	54.44	N2	
4.35	**1.21**	**0.775**	**0.57**	**2.831**	**LSD**	
H						
48.46	76.88	43.52	6.56	43.89	H0	
50.58	82.29	46.53	7.89	49.22	H1	
55.18	88.72	50.08	8.67	52.78	H2	
4.35	**1.21**	**0.775**	**0.57**	**2.831**	**LSD**	
N * H						
40.00	64.14	37.77	4.67	40.33	H0	N0
48.58	68.94	40.29	6.67	44.00	H1	
51.75	74.81	45.28	7.00	49.33	H2	
54.00	78.53	41.55	5.67	43.00	H0	N1
48.56	84.69	46.29	7.33	47.00	H1	
56.57	90.84	049.6	8.67	50.67	H2	
51.37	87.96	51.23	9.33	48.33	H0	N2
54.60	93.25	53.01	9.67	56.67	H1	
57.22	100.50	55.35	10.33	58.33	H2	
N.S	**N.S**	**1.34**	**0.99**	**N.S**	**LSD**	

The results in Table 3 showed a significant superiority in the treatment involving spraying with neem leaf extract. The treatment (N2) excelled in most of the studied floral growth traits, including the number of flowers, flower diameter, flower stalk length, vase life, and bulb characteristics (number and weight of bulbs). These values reached (9.78 flowers plant^{-1}, 9.206 cm, 45.81 cm, 8.111 days, 1.67 bulbs/plant, and 45.19 g, respectively), compared to untreated plants sprayed with distilled water only, which recorded (3.00 flowers/plant, 5.123 cm, 34.87 cm, 4.778 days, 0.67 bulbs plant^{-1}, and 28.23 g, respectively).

The results also highlights a clear and significant improvement in floral and bulb traits as a result of fenugreek seed infusion. Treatment H2 (10 g L^{-1}) showed marked enhancement in most measured parameters, with the number of flowers reaching 7.33 flowers plant^{-1}, flower diameter 7.634 cm, flower stalk length 43.32 cm, vase life 7.333 days, number of bulbs 1.22 bulbs plant^{-1}, and bulb weight 40.65 g, compared to control plants sprayed with distilled water only, which recorded (5.00 flowers plant^{-1}, 6.277 cm, 37.46 cm, 5.778 days, 1.11 bulbs/plant, and 32.84 g, respectively).

Moreover, the interaction between the two factors revealed a statistically significant improvement in several floral and bulb-related traits. The combined treatment N2H2 recorded the highest values for flower diameter (10.733 cm), flower stalk length (49.48 cm), and flower longevity (9.667 days), as well as bulb weight (52.39 g), significantly outperforming the control treatment. However, Table 3 also indicates that the interaction had no significant effect on the number of flowers and the number of bulbs per plant.

Discussion

Based on the results in Tables 2 and 3, both neem leaf extract and fenugreek seed infusion had a statistically significant effect on vegetative growth traits. The marked improvement in plant height may be attributed to the presence of phenolic compounds and plant growth regulators—such as auxins—in both treatments, which promote cell division and elongation (2). The observed increase in leaf number and chlorophyll content may result from these treatments' overall enhancement of vegetative development and stimulation of pigment biosynthesis. The positive impact on fresh and dry biomass likely stems from improved photosynthetic activity and enhanced nutrient transport, leading to greater accumulation of organic matter (7).

As for floral growth traits and bulb yield, the effect of the neem leaf extract and fenugreek seed infusion had a significant effect on increasing the number of flowers (Table 3), perhaps due to the seeds containing... Fenugreek and neem leaves contain some growth regulators, such as auxins, cytokinins, minerals, and vitamins, which play a role in increasing the number of flowers. These results are consistent with (5). The reason for the increase in flower diameter, flower stalk length, and the increase in the number of days of flower life may be due to the effect of treatments that contributed to improving the photosynthesis process, leading to floral development and increased production of gibberellins, which led to increased division and consequently increased flower stalk length (12). Their role in increasing flower lifespan may also be due to the presence of antioxidants in the treatments, which reduce specific enzymes that degrade petal cells (14).

The slight improvement in the number and weight of bulbs may be associated with the extracts' ability to stimulate the development of storage organs and enhance nutrient uptake. This, in turn, led to

increased bulb formation and mass. These results are consistent with what Ahmad et al. (1) reported on the ability of plant extracts to improve the physiological characteristics of plants. Decoration without harmful impact on the environment or human health.

Table 3. Effect of foliar application of certain plant extracts (neem leaf extract and fenugreek seed infusion) on the floral growth of Narcissus plants

Bulb weight (g)	Number of bulbs (bulbs plant^{-1}) |	Vase life (days)	Flower stalk length (cm)	Flower diameter (cm)	Number of flowers (flowers plant^{-1})	Treatments	
N							
28.23	0.67	4.778	34.87	5.123	3.00	N0	
37.25	1.44	6.778	41.93	6.874	5.78	N1	
45.19	1.67	8.111	45.81	9.206	9.78	N2	
2.25	**0.55**	**0.486**	**0.75**	**0.366**	**0.68**	**LSD**	
H							
32.84	1.11	5.778	37.46	6.277	5.00	H0	
37.18	1.44	6.556	41.82	7.292	6.22	H1	
40.65	1.22	7.333	43.32	7.634	7.33	H2	
2.25	**N.S**	**0.486**	**0.75**	**0.366**	**0.68**	**LSD**	
N * H							
25.97	0.33	4.667	31.93	4.877	2.33	H0	N0
29.77	1.00	5.000	36.37	5.583	3.00	H1	
28.96	0.67	4.667	36.30	4.910	3.67	H2	
32.99	1.33	6.000	39.03	6.287	4.33	H0	N1
38.14	1.67	6.667	42.58	7.077	5.67	H1	
40.61	1.33	7.667	44.17	7.260	7.33	H2	
39.55	1.67	6.667	41.42	7.667	8.33	H0	N2
43.64	1.67	8.000	46.52	9.217	10.00	H1	
52.39	1.67	9.667	49.48	10.733	11.00	H2	
3.90	**N.S**	**0.841**	**1.29**	**0.634**	**N.S**	**LSD**	

CONCLUSION

Results from this study reveal that foliar spray with natural extracts, especially neem leaf extract and fenugreek seed soak, could be effectively used to improve vegetative growth, flowering attributes, and bulb yield of Narcissus plants (*Narcissus spp*). The application neem extract 10 g L^{-1} (N_2) was the best among the treatments that had the most significant enhancement of most vegetative parameters as plant height, leaf number, chlorophyll content and floral and bulb production were recorded. Such synergistic effects were also observed in other studies when both neem and fenugreek extracts were applied simultaneously, especially in the increased content of chlorophyll in the leaves as well as in some floral traits.

These findings indicate that plant extracts may act as efficient, environmentally friendly substitutes to the synthetic growth promoters in ornamental horticulture, promoting the use of green manures, and avoiding negative influence on plant quality as well as the environment.

RECOMMENDATIONS

1. Use neem leaf extract to enhance vegetative and floral characteristics, bulb yield, and provide biological protection.
2. Adopt fenugreek seed extract in biofertilization programs for bulbous plants.
3. Conduct further field studies to evaluate the long-term effects under different environmental conditions

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