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Effect of foliar application on humic acid and NPK levels on growth and yield of Niger (*Guizotia abyssinica* L.) in Prayagraj District

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Abstract

The study was carried out in irrigated conditions during the *Rabi* season of 2025-2026 to determine the effect on foliar application Humic Acid and NPK Levels on Growth and yields of Niger (*Guizotia abyssinica*) in the Prayagraj district the experiment was set up as a randomized block design in 10 Treatment and 3 replications at the Faculty of Agriculture in Prof. Rajendra Singh (Rajju Bhaiya) University, Prayagraj. The treatment combination are as follows (T₁) Humic Acid 2.5% + NPK (10:25:25), (T₂) Humic Acid 2.5% + NPK (20:30:30), (T₃) Humic Acid 2.5% + NPK (30:40:40), (T₄) Humic Acid 5% + NPK (10:25:25), (T₅) Humic Acid 5% + NPK (20:30:30), (T₆) Humic Acid 5% + NPK (30:40:40), (T₇) Humic Acid 7.5% + NPK (10:25:25), (T₈) Humic Acid 7.5% + NPK (20:30:30), (T₉) Humic Acid 7.5% + NPK (30:40:40), (T₁₀) Control (Farmer Practices)

Keywords: Niger crop humic acid, NPK level, foliar application, growth, yield

Introduction

Niger crop (*Guizotia abyssinica* Cass.) is a member of the Asteraceae family. It is a valuable oilseed crops that also has therapeutic qualities which is mostly cultivated in India and Ethiopia. It is also known by other names, including noog, nyger, nyjer khursani, and others Niger crop provides about 3% of Indian oilseed output and 50% of Ethiopian oilseed production (Adarsh *et al.*, 2014) ^[1]. Niger seeds contain 40% oil and 20% protein, the edible oil extracted from Niger seeds have a “nutty flavor and a nice odor” (Dakanwale, 2018) ^[5].

It is primarily used in food preparation, manufacturing of cosmetics and soaps, painting of buildings, and lubrication of machinery. Niger seed is exported as bird feed, generating revenue for the nation and generating foreign currency. Despite the fact that it is an oil seed crop, the potential of Niger has not been fully explored owing to the poor producing capacity of its cultivars and sensitivity to a variety of abiotic and biotic stressors (Ghane *et al.*, 2012) ^[7]. However, although a crop's yield is determined by its cultivars, its environment plays a significant influence in determining the potential yield of a cultivars within its genetic limit. One of the most important objectives in agriculture is to determine the optimal plant density for producing the required yield. It was also shown that increasing density resulted in increased seed output, Furthermore, all of these factors have an impact on crop development, seed production, and quality characteristics (G. D. Gadade *et al.*, 2014) ^[6]. Humic acid is one of the most important components of the bio liquid complex, and it is abundant in soil, it is not a fertilizer, although it may be used in conjunction with fertilizer to enhance its effectiveness. It has a wide variety of positive impacts on agricultural production as a result of its molecular structure, it aids in the transfer of micronutrients from the soil to the plant, improves water retention, increases seed germination rates, improves water, air, and root penetration. Since this crop was cultivated for the first time in Erbil governorate IKR for this reason some factors were selected in this study such as cultivars, the plant geometry (distance between rows), humic acid and their interaction in order to study the effect of cultivars, plant geometry, humic acid and growth, yield and their components. Niger (*Guizotia abyssinica* Cass.) In various areas of the nation, it is referred to as ramtil, jagni or jatangi

(Hindi), ramtal (Gujrati), karale or khurasani (Marathi), uhechellu (Kannada), payellu (Tamil), verrinuvvulu (Telugu), alashi (Oriya), sarguza (Bengali), ramtil (Punjabi), and sorguja (Assamese). Despite being regarded as a small oilseed crop, niger is significant due to its 32–40% high oil content and 18–24% protein content. Niger oil dries slowly and is used as an illuminant, paint, food, and soap. It can be tainted with rapeseed, sesame, or linseed oil and is used in place of olive oil. Cooking uses the oil. The seed's oil is used to cure scabies and burns. The seed is used as a condiment and consumed fried. Livestock feed is made from the oil extraction press cake.

Niger oil contains less than 70% unsaturated fatty acids that are devoid of contaminants and has high shelf life. The oil is said to be beneficial to health. In the pre-flowering period, whole plants are utilized as green manure. Plants are utilized as "bee plants." Even with insufficient soil fertility, moisture stress, and inadequate crop management, the crop can produce more seeds. Niger has the benefit of producing oil and a high level of resistance to illness, insect pests, and animal attacks. Niger has a lot of possibilities for conserving soil. Because of these characteristics, it may be grown on steep terrain as well as marginal and sub-marginal ground in and surrounding forests. Niger is mostly cultivated in input-starved tribal areas of India on depleted soils. Additionally, it is the foundation of the tribal economy and agriculture. In terms of Niger production, export, and area, India leads the globe. Niger crops thrive without the need of pesticides. Under ideal growth circumstances, it may produce 800–1000 kg/ha. This crop is perfect for contingent cropping under rainfed conditions because to its low seed rate, capacity to grow on a variety of soils, and sowing time, which runs from the beginning of the monsoon in June to September or October. Niger's production is low—between 300 and 350 kg/ha in India. Despite a 42% decline in the region during 1965–1966, Niger output climbed by 7% and productivity by 88% in 2012–13. Andhra Pradesh had the highest seed yield of 750 kg/ha in 2012–13, whereas Madhya Pradesh has the largest acreage (86.9 thousand hectares) and production (29.8 thousand tones).

Materials and Methods:

The field experiment was conducted at the farm of College of

Agriculture, Prof. Rajendra Singh (Rajju Bhaiya) University Naini Prayagraj during winter (Rabi) season of 2024-25 and 2025-26. The experiment site falls in a subtropical climate situated at (25° 24' N latitude, and 81° 51' E longitude) and 98 m above mean sea levels. Agro climatically, Prayagraj, Uttar Pradesh, the Niger crop (*Guizotia abyssinica*) is primarily grown as a minor oilseed. It is successfully cultivated in the Rabi season (winter) in regions with sufficient residual soil moisture or minimal irrigation. Niger is a hardy, short-day plant that performs well in the sub-tropical climate of Eastern Uttar Pradesh. The experiment is to be done in a Factorial Randomized Block Design (RBD) which composed of 10 treatments in 3 replications. The data for growth and yield attributes of Indian Niger is to be recorded using five random chosen plants from each treatment after seed sowing. Treatments comprised of T₁-Humic Acid 2.5% + NPK (10:25:25), T₂-Humic Acid 2.5% + NPK (20:30:30), T₃-Humic Acid 2.5% + NPK (30:40:40), T₄-Humic Acid 5% + NPK (10:25:25), T₅-Humic Acid 5% + NPK (20:30:30), T₆-Humic Acid 5% + NPK (30:40:40), T₇-Humic Acid 7.5% + NPK (10:25:25), T₈-Humic Acid 7.5% + NPK (20:30:30), T₉-Humic Acid 7.5% + NPK (30:40:40), T₁₀-Control (Farmer Practices). One foliar spray of humic acid, were given at 30 DAS and 60 DAS.

Results and Discussion

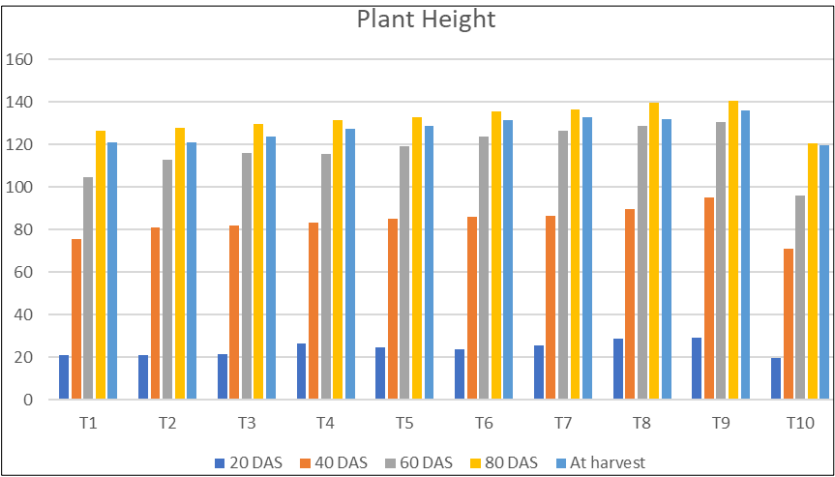
Growth parameter

Plant height (cm)

The results clearly demonstrate that foliar application of Humic Acid 7.5% along with NPK (30:40:40) (T₉) was the most effective treatment for increasing plant height of niger. Therefore, this treatment can be recommended for improving vegetative growth and achieving better crop performance under similar agro-climatic conditions. And overall vegetative growth similar findings were reported by Canellas *et al.* (2002)^[4], who observed that humic substances stimulate root growth and nutrient absorption, resulting in improved plant development. Nardi *et al.* (2002)^[10] also reported that humic substances enhance plant metabolism and nutrient utilization, leading to better vegetative growth.

Table 1: Effect on Foliar Application of Humic Acid and NPK levels on plant height(cm)

Treatments		Plant height (cm)				
		20 DAS	40 DAS	60 DAS	80 DAS	At harvest
T ₁	Humic Acid 2.5% + NPK (10:25:25)	20.80	75.44	104.58	126.37	120.96
T ₂	Humic Acid 2.5% + NPK (20:30:30)	21.02	80.83	112.75	127.92	121.07
T ₃	Humic Acid 2.5% + NPK (30:40:40)	21.59	82.07	116.18	129.61	123.93
T ₄	Humic Acid 5% + NPK (10:25:25)	26.56	83.21	115.56	131.47	127.22
T ₅	Humic Acid 5% + NPK (20:30:30)	24.78	85.03	118.97	132.79	128.94
T ₆	Humic Acid 5% + NPK (30:40:40)	23.56	85.87	123.74	135.56	131.68
T ₇	Humic Acid 7.5% + NPK (10:25:25)	25.34	86.48	126.65	136.56	132.65
T ₈	Humic Acid 7.5% + NPK (20:30:30)	28.56	89.46	128.64	139.75	131.92
T ₉	Humic Acid 7.5% + NPK (30:40:40)	29.17	94.98	130.47	140.65	136.23
T ₁₀	Control (Farmer Practices)	19.45	70.75	95.79	120.76	119.57
SEm (±)		1.51	1.84	1.97	2.14	3.21
CD at 5%		-	5.45	5.74	6.46	9.63



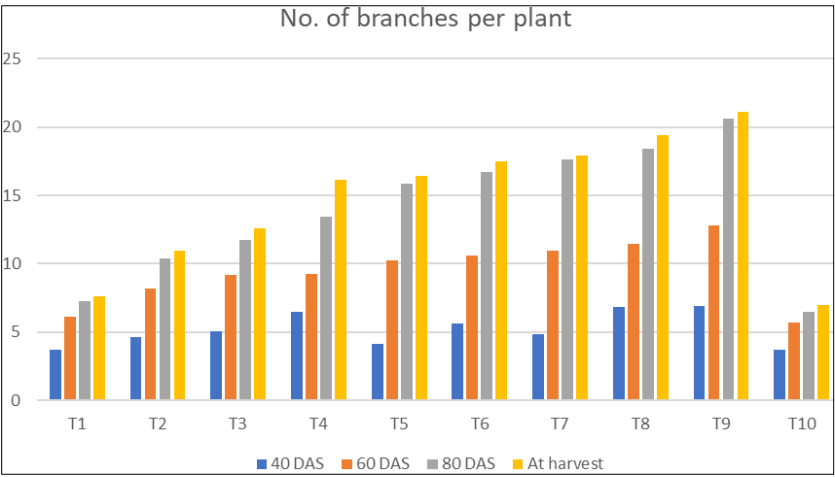
No. of Branches

The results clearly demonstrate that foliar application of Humic Acid 7.5% along with NPK (30:40:40) (T₉) was the most effective treatment for increasing the number of branches per plant in niger. Therefore, this treatment can be recommended for promoting

vegetative growth and improving crop performance under similar agro-climatic conditions. Resulting in vigorous vegetative growth and increased branch formation. Similar beneficial effects of humic substances on plant growth and development have been reported in previous studies.

Table 2: Effect on Foliar Application of Humic Acid and NPK levels on Number of branches per plant

Treatments		Number of branches per plant			
		40 DAS	60 DAS	80 DAS	At harvest
T ₁	Humic Acid 2.5% + NPK (10:25:25)	3.71	6.08	7.25	7.60
T ₂	Humic Acid 2.5% + NPK (20:30:30)	4.65	8.20	10.35	10.95
T ₃	Humic Acid 2.5% + NPK (30:40:40)	5.05	9.15	11.75	12.55
T ₄	Humic Acid 5% + NPK (10:25:25)	6.49	9.25	13.41	16.15
T ₅	Humic Acid 5% + NPK (20:30:30)	4.15	10.25	15.85	16.40
T ₆	Humic Acid 5% + NPK (30:40:40)	5.65	10.57	16.67	17.45
T ₇	Humic Acid 7.5% + NPK (10:25:25)	4.84	10.95	17.66	17.89
T ₈	Humic Acid 7.5% + NPK (20:30:30)	6.84	11.42	18.40	19.41
T ₉	Humic Acid 7.5% + NPK (30:40:40)	6.90	12.79	20.58	21.13
T ₁₀	Control (Farmer Practices)	3.68	5.68	6.45	6.96
SEm (±)		0.15	0.29	0.44	1.45
CD at 5%		-	0.89	1.36	4.21



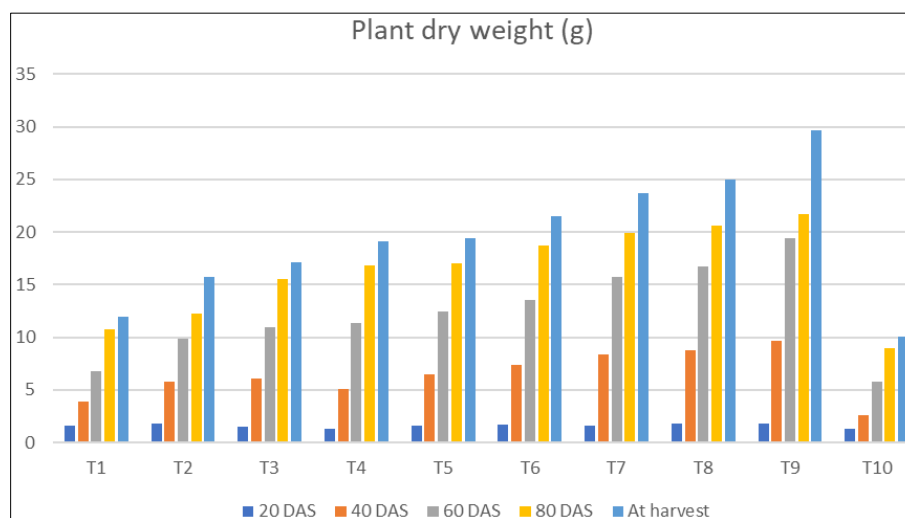
Plant dry weight (g)

The application of growth regulators greatly demonstrated that foliar application of Humic Acid 7.5% along with NPK (30:40:40) (T₉) was the most effective treatment for increasing plant dry weight of niger. Therefore, this treatment can be recommended for improving biomass accumulation, vegetative growth and overall crop performance under similar agro-climatic conditions. Nahid Amoozad and Morteza Zahedi.2024 ^[2] shows in his research that the application of Humic acid increase root weight and shoot weight. T₉ (Humic Acid 7.5% + NPK 30:40:40)

recorded the highest plant dry weight at all growth stages, with 1.84 g, 9.65 g, 19.36 g, 21.74 g and 29.66 g plant⁻¹ at 20, 40, 60, 80 DAS and at harvest, respectively. The increase in dry matter accumulation under T₉ may be attributed to the combined effect of humic acid and balanced NPK nutrition, which enhanced nutrient uptake, chlorophyll formation, photosynthetic efficiency, enzyme activity and assimilate translocation, thereby increasing biomass production. Humic substances are known to stimulate root growth and nutrient-use efficiency, resulting in greater dry matter accumulation and improved crop growth.

Table 3: Effect on Foliar Application of Humic Acid and NPK levels on Plant dry weight (g)

Treatments		Plant dry weight (g)				
		20 DAS	40 DAS	60 DAS	80 DAS	At harvest
T ₁	Humic Acid 2.5% + NPK (10:25:25)	1.56	3.91	6.81	10.78	11.98
T ₂	Humic Acid 2.5% + NPK (20:30:30)	1.76	5.75	9.82	12.24	15.74
T ₃	Humic Acid 2.5% + NPK (30:40:40)	1.50	6.12	10.96	15.48	17.08
T ₄	Humic Acid 5% + NPK (10:25:25)	1.26	5.09	11.39	16.84	19.09
T ₅	Humic Acid 5% + NPK (20:30:30)	1.62	6.48	12.44	17.01	19.41
T ₆	Humic Acid 5% + NPK (30:40:40)	1.67	7.36	13.54	18.72	21.45
T ₇	Humic Acid 7.5% + NPK (10:25:25)	1.59	8.39	15.74	19.94	23.68
T ₈	Humic Acid 7.5% + NPK (20:30:30)	1.81	8.72	16.73	20.55	24.93
T ₉	Humic Acid 7.5% + NPK (30:40:40)	1.84	9.65	19.36	21.74	29.66
T ₁₀	Control (Farmer Practices)	1.26	2.57	5.78	8.91	10.05
S.Em (±)		0.11	0.24	0.32	0.36	0.41
CD at 5%		-	0.76	0.99	1.12	1.26



Yield

Seed Yield (q ha⁻¹)

The data presented in Table 4 revealed that foliar application of humic acid and NPK significantly influenced seed yield of niger. Among the treatments, T₉ (Humic Acid 7.5% + NPK 30:40:40) recorded the highest seed yield (11.16 q ha⁻¹), followed by T₈ (10.86 q ha⁻¹), whereas the lowest seed yield (3.13 q ha⁻¹) was recorded under T₁₀ (Control). The increase in seed yield under T₉ may be attributed to improved nutrient uptake, enhanced photosynthetic efficiency and better translocation of assimilates from source to sink, resulting in improved seed development. Similar findings were reported by Calvo *et al.* (2014) [3], who observed that humic substances act as plant bio stimulants and improve crop productivity. Balanced NPK nutrition has also been reported to increase seed yield through improved nutrient availability and metabolic activities (Marschner, 2012) [8].

Straw Yield (q ha⁻¹)

Straw yield was significantly influenced by foliar application of humic acid and NPK. The highest straw yield (61.73 q ha⁻¹) was recorded under T₉, followed by T₈ (59.26 q ha⁻¹), whereas the lowest straw yield (33.85 q ha⁻¹) was observed in the control. Higher straw yield under T₉ may be due to enhanced vegetative growth, improved chlorophyll content and greater biomass accumulation resulting from efficient nutrient absorption. Similar observations were reported by Nardi *et al.* (2002) [10], who concluded that humic substances improve nutrient utilization and

vegetative growth in crops.

Biological Yield (q ha⁻¹)

Biological yield increased significantly with increasing concentrations of humic acid and NPK. The highest biological yield (72.90 q ha⁻¹) was recorded under T₉, followed by T₈ (70.12 q ha⁻¹), while the lowest (36.99 q ha⁻¹) was recorded in the control treatment. The increase in biological yield may be attributed to enhanced biomass production due to improved nutrient uptake, greater photosynthetic activity and increased dry matter accumulation. Similar findings were reported by Nardi *et al.* (2017) [9], who stated that humic substances stimulate plant metabolism and biomass production through improved root-soil interactions.

Harvest Index (%)

Harvest index was also improved by foliar application of humic acid and NPK. The highest harvest index (15.49%) was recorded under T₉, followed by T₈ (15.32%), whereas the lowest (8.47%) was observed in the control. The higher harvest index under T₉ indicates more efficient partitioning of photosynthates towards economic yield due to balanced nutrient availability and enhanced physiological efficiency. Similar findings have been reported by Marschner (2012) [8], who explained that balanced mineral nutrition improves assimilate partitioning and increases harvest index.

Table 4: Effect on Foliar Application of Humic Acid and NPK levels on Yield

Treatments		Yield			
		Seed yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
T ₁	Humic Acid 2.5% + NPK (10:25:25)	3.64	35.68	39.33	9.27
T ₂	Humic Acid 2.5% + NPK (20:30:30)	4.96	41.64	46.61	10.65
T ₃	Humic Acid 2.5% + NPK (30:40:40)	5.45	44.89	50.35	10.84
T ₄	Humic Acid 5% + NPK (10:25:25)	6.92	46.85	53.78	12.88
T ₅	Humic Acid 5% + NPK (20:30:30)	7.42	49.36	56.79	13.08
T ₆	Humic Acid 5% + NPK (30:40:40)	8.67	56.85	65.53	13.24
T ₇	Humic Acid 7.5% + NPK (10:25:25)	9.27	58.45	67.72	13.69
T ₈	Humic Acid 7.5% + NPK (20:30:30)	10.86	59.26	70.12	15.32
T ₉	Humic Acid 7.5% + NPK (30:40:40)	11.16	61.73	72.90	15.49
T ₁₀	Control (Farmer Practices)	3.13	33.85	36.99	8.47
S.Em (±)		1.41	63.57	68.37	0.64
CD at 5%		4.41	198.05	213.02	-

Conclusion

The current study's findings showed that applying humic acid and NPK together greatly enhanced safflower plant growth and yield characteristics compared to the control. The maximum plant height, dry matter accumulation, number of branches per plant, seed yield, straw yield, biological yield, and harvest index were all reported by T* (Humic Acid 7.5% + NPK 30:40:40). Therefore, in the circumstances of the current study, the application of Humic Acid 7.5% in conjunction with NPK (30:40:40) might be suggested as the most efficient nutrient management technique for boosting safflower growth and production.

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