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ASSESSING THE INFLUENCE OF AIR POLLUTANTS ON ROOT KNOT NEMATODE INFESTATIONS IN CHOSEN PULSE CROPS

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Abstract

Pulses are the mainstay of the Indian cuisine and are essential to the security of the growing Indian population's nutrition and means of subsistence. However, a number of biotic pressures severely hinder the production of pulses, making it extremely difficult to satisfy the population's future demands in India. Root knot nematodes (RKN) are a significant danger to crop output among other biotic stressors. Meloidogyne species, or root knot nematodes, are obligatory, stationary root endoparasites that are part of a highly significant group of plant-parasitic nematode genera in terms of economic importance. The purpose of this study was to investigate the relationship between air pollution, soil physicochemical characteristics, and pulse crops' vulnerability to root knot nematode infections. The study found substantial relationships between soil pH, organic matter content, and nematode infection levels, as well as their linkages with exposure to air

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pollutants, through a thorough investigation of soil samples from several pulse crop cultivation areas.

Keywords: *Air Pollutants, Root Knot Nematodes, Pulse Crops, Agricultural Impact, Soil Health*

1. INTRODUCTION

Air, water, land, noise, and radioactive pollution have all had detrimental effects on the environment, negatively affecting not just humans but also microbes, plants, and all other living organisms found in the many ecosystems. India has demonstrated remarkable progress in the fields of technology, agriculture, and urbanisation, all while maintaining a rapid pace of growth. These advancements have brought us benefits and drawbacks in equal measure along their mutually beneficial path. It pulled different undesirable alterations to the terrestrial, chemical, and biological settings of the ecosystems that are found all across the biosphere. Mistakes in the emission of gases, particulate matter, and hazardous substances are persistent throughout multiple industries, and they are persistently recirculating into our surroundings. These bodily components are contaminating our environment to the point where they are preparing a time-consuming risk to our development. A pollutant is any component of the problem that, when given to the environment without removing any link in a way that would, in one's opinion, cause a negative alteration in the environment in the past. Am relay pollution, one of the most prevalent forms of pollution, disturbs the natural equilibrium of the atmosphere in addition to having a major and pervasive detrimental effect on many of the species that support human life. Substances known as air pollutants are those that, according to the design of the television, lead to an undesirable conclusion or nirvana. Blotter Water droplets, chemicals, gases, and suspended or deposited particle debris are a few of the mean beam contaminants. A wish list exists of the beam pollutants that are released into the atmosphere from many sources. Each of these pollutants affects the animals and ecosystems within them profoundly and over time.

1.1. Air Pollutant

The Pollution (Prevention and Control) Act of 1981 states that air pollutants are defined as solid, liquid, or gaseous substances that are present in the atmosphere and have the potential to harm

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biological systems, including humans, other living things, plants, property, and the environment. Despite the fact that many of these compounds are formed by natural processes and are typically found in very small concentrations in the environment, it is nevertheless believed that they are safe for ingestion by humans. On the other hand, these substances are only regarded as air pollutants when their concentrations surpass naturally occurring values and start to have adverse effects.

Air pollutants include a wide range of substances, including particulate matter, sulphur dioxide, nitrogen oxides, carbon monoxide, and volatile organic compounds. Many different compounds fall within the category of air pollutants. The above list includes a few of the more well-known ones. These pollutants can originate from a wide range of sources, including motor vehicle emissions, manufacturing processes, agricultural practises, and natural events like forest fires and volcanic eruptions. When these substances are discharged into the atmosphere in significant amounts, they may have a number of detrimental effects, including as harm to ecosystems and issues with the cardiovascular and respiratory systems.

1.2.Importance of Pulses

over one-third of India's land is dedicated to the cultivation of more than a dozen different pulse crops, which accounts for over one-fourth (23%) of the world's total pulse production. India is the world's largest producer of grain legumes as a result of ranking first in both the production and consumption of pulses. Legume is an important part of the diets of a huge number of people living in poverty in countries that are still developing economically. Vigna radiata (L.) Wilczek is one of the most significant pulse crops grown during the Kharif season. Due to an increase in land area from 23.63 million hectares to 18.24 million hectares in 2010–11, India's output of pulses surged drastically from 14.76 million tonnes in 2007–08 to 18.24 million tonnes in 2010–11. In India, mung bean farming makes up 14.0 percent of the entire pulse area and yields 7.0 percent of the country's total output of pulses. The plant that yields mungbean, sometimes referred to as mung, green gramme, or golden gramme, is Vigna radiata (L.) R. Wilczek. India is the nation that produces the most mungbean, with an annual total output of 1.42 million tonnes and a total cultivated land area of about 3 million hectares, according to Singh and Ahlawat's (2005) research. Despite producing between 10 and 12 million tonnes of food grains from 23 million hectares of

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land area producing these crops over the past three decades, the nation has not been able to achieve self-sufficiency in pulse requirements due to the size of its population and the alarming rate at which it is growing.

1.3.Management of Root - Knot Nematodes

This decreased production of pulses has negatively affected their availability; daily per capita availability of pulses has steadily decreased from a peak of 64 grammes achieved in the 1950s to less than 40 grammes currently, in contrast to the FAO/WHO proposal of a minimum pulse requirement of 80 grammes per capita.

Cover crops, particularly those grown for soil improvement or as fodder, may be harmful to nematodes. By cultivating particular cover crops especially for that reason, nematodes can be managed. Cover crops that are known to suppress multiple varieties of Meloidogyne include castor (Ricinus communis), oats (Avena spat), velvet beans (Mttcnna pruriens), sorghum (Sorghum bicolor), Crolalaria spectabilis, and sunnhemp (C juncea). Other types of cover crops are: However, when suppressive pivot cover crops are replaced with crops that are defenceless against the infection, their effects often fade quickly. Therefore, knowledge of the nematodes that are now present as well as the susceptibility of the crops that will be employed is necessary in order to properly employ cover crops for nematode control.

The majority of the time, root knot nematodes are hidden by using cover crops and green manure, both of which encourage the soil's maturity by allowing nutrients to slowly seep into the soil as they decompose. The amount of time needed for cover crops or green waste to completely decompose varies and may need to be done year-round. It has been demonstrated that both cover crops and green manure contribute to the populations of microscopic creatures, growth, and other beneficial microorganisms in the soil, all of which can help reduce the number of root knot nematodes.

Examples of soil amendments that can increase the quantity of microorganisms that are antagonistic to nematodes are compost and mulches with a high organic matter content. Three other techniques for managing insect populations include crop rotation, clean fallow, and resistant

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types. Cultural practises like fallowing and crop rotation are not practised widely since arable land is scarce. Additionally, because root knot nematodes can infect a wide range of host plants, these practises are ineffective. The most economical and realistically relevant approach is to utilise resistant cultivars, but most farmers lack access to them. Because of the difficulties associated with industrial production, the imbalanced condition of biodiversity, and the difficulty of smallholder farmers to afford it, the use of biological control is restricted.

2. LITERATURE REVIEW

The huge risk that root-knot nematodes provide to the process of agricultural output is highlighted by Chitwood's (2003) remark. Microscopic worms called root-knot nematodes contaminate plant roots and do significant harm. Consequently, root-knot nematodes cause large financial losses to the agricultural sector. The destruction resulting in yearly losses over 125 billion USD is the fault of these parasites.

In the context of a symbiotic relationship between plants and bacteria that can fix nitrogen, Damiani et al. (2012) look at the intricate processes involved in the formation of nodules on plant roots. These "colour compounds" are probably secondary metabolites or signalling molecules that the bacteria make and which are essential for initiating a series of genetic responses in the plant's rhizome.

Hurek et al. (2002) reported that the entophytic nitrogen fixers were instructed to desist from their ad-lib development and had improved. Pulses are widely recognised for being a great source of proteins and rare dilatory fibres, both of which are essential for preserving physical and mental well-being. demonstrates a significant improvement in ad-lib growth and the elimination of a particular problem that may be related to illnesses or pests and is caused by bacteria that produce root nodules.

The impact of the root pathogen Meloidogyne incognita, commonly referred to as the root-knot nematode, on the growth and yield of black gramme (Vigna mungo) plants are examined by Bhat et al. (2009). The research indicates that the growth and productivity of black gramme plants are significantly slowed down when this nematode is present.

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In a 2011 study, Singh examined the temporal variations in soybean plant susceptibility to root-knot nematode infections. A particular kind of small roundworm known as a "root-knot nematode" feeds on plant roots and can seriously damage crops like soybeans. Finding solutions to reduce the harm these nematodes inflicted on soybean plants was the aim of Singh's research.

The link between root-knot nematodes and root-nodule bacteria is discussed in the paper by Bhat et al. (2009), along with possible inoculation strategies for managing these pests in a range of crops. A interesting and complex aspect of soil ecology and the interactions between plants and microbes, the relationship between root-knot nematodes and root-nodule bacteria has significant implications for agricultural practises.

3. RESEARCH METHODOLOGY

3.1.Research Design

In order to examine the association between soil physicochemical characteristics and pulse crops' susceptibility to root knot nematode infestations under different air pollution exposure levels, a correlational research methodology was used for this study. Multiple pulse crop samples were collected from various agricultural sites using a cross-sectional strategy to gather data. Using a descriptive research methodology, the physiological and biochemical reactions of pulse crop plants to air pollutants were analysed in order to comprehend alterations in root architecture, nutrient uptake efficiency, and defence mechanisms against infestations by root knot nematodes.

3.2.Data Collection:

Comprehensive field surveys and laboratory analyses were used to gather data. Various locations for the production of pulse crops provided soil samples, and conventional laboratory procedures were used to measure the pertinent physicochemical parameters. The degree of nematode infection was ascertained by closely examining soil samples under a microscope. With the use of the proper air quality monitoring equipment, exposure levels to air pollutants were documented. Using specialised tools and assays, the physiological and biochemical responses of pulse crop plants were measured, and the resulting data were documented appropriately.

3.3.Ethical Consideration

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Strict adherence to ethical principles ensured the health of agricultural growing areas and the prudent use of resources prior to data collection. The study adhered to all required procedures for soil sampling and analysis, and landowners and the appropriate agricultural authorities gave their assent. The research team ensured the confidentiality of the data obtained and the integrity of the study's conclusions by adhering to all ethical rules and laws.

3.4. Statistical Analysis

Several statistical techniques were applied to the analysis of the gathered data. The study employed correlation analysis to investigate the associations among the many variables that were reported. The data in the article was summarised and interpreted using descriptive statistics, which provided information about the distribution and properties of the variables that were gathered.

4. DATA ANALYSIS

4.1. Objective 1

To examine the correlation between soil physicochemical properties (e.g., pH, organic matter content, nutrient levels) and the susceptibility of pulse crops to root knot nematode infestations under varying air pollutant exposure levels.

Table 1: Soil-Plant-Nematode Information Matrix

Sample ID	pH	Organic Matter (%)	Nitrogen (mg/kg)	Phosphorus (mg/kg)	Potassium (mg/kg)	Nematode Infestation Level	Air Pollutant Exposure (ug/m^3)
1	6.5	2.3	120	25	150	Moderate	50
2	7	2.8	150	30	170	Low	30
3	5.5	1.5	100	20	120	High	70
4	6.8	2	110	22	130	Moderate	45
5	6	1.8	90	18	110	High	60
6	7.2	3	160	35	180	Low	25

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7	6.3	2.5	130	28	160	Moderate	55
8	5.8	1.7	95	19	115	High	65
9	6.9	2.2	115	24	140	Low	35
10	6.6	2.6	140	32	165	Moderate	40

A thorough summary of the many physicochemical characteristics of soil, the vulnerability of pulse crops to infestations by root knot nematodes, and the associated exposure levels to air pollutants are provided in Table 1. According to the statistics, the average pH of the soil is 6.5, however it can range from 5.5 to 7.2. Across the samples, the soil's organic matter level ranges from 1.5% to 3.0%, indicating moderate fertility. The range of nitrogen concentrations is 90–160 mg/kg, with an average of 120 mg/kg. In a similar vein, potassium and phosphorus concentrations range from 110 to 180 mg/kg and 18 to 35 mg/kg, respectively.

The data shows that the pulse crops had varying degrees of nematode infestation, ranging from low to high susceptibility. Most samples have moderate levels of infestation. Remarkably, 40% of the samples exhibit a moderate level of infection, whereas 30% and 40% of the samples, respectively, show high and low levels of infestation. In addition, the average exposure level to air pollutants is 45 micrograms per cubic metre (ug/m3), with a range of 25 to 70 ug/m3.

There seems to be a possible association between the nutritional content of the soil and the vulnerability of pulse crops to root knot nematode infections, based on an analysis of the relationship between the physicochemical features of the soil and the degrees of nematode infestation. Notably, lower soil pH and organic matter concentration appear to be correlated with higher infestation levels.

Table 2: Soil Plant Nematode Correlation Table

	pH	Organic Matter	Nitrogen	Phosphorus	Potassium	Nematode	Air Pollutant

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						Infestation	Exposure
pH	1	-0.82	-0.65	-0.42	-0.56	-0.43	0.52
Organic Matter	-0.82	1	0.78	0.63	0.71	0.31	-0.68
Nitrogen	-0.65	0.78	1	0.82	0.88	0.25	-0.55
Phosphorus	-0.42	0.63	0.82	1	0.7	-0.14	-0.3
Potassium	-0.56	0.71	0.88	0.7	1	0.18	-0.45
Nematode Infestation	-0.43	0.31	0.25	-0.14	0.18	1	0.37
Air Pollutant Exposure	0.52	-0.68	-0.55	-0.3	-0.45	0.37	1

The relationships between several important variables in regard to the cultivation of pulse crops and nematode infestation are shown in Table 2. According to the data, there is a significant negative connection (r = -0.82) between soil pH and organic matter content, indicating that organic matter concentration tends to increase when soil pH drops. Furthermore, the table shows a moderately positive association (r = 0.88) between the levels of nitrogen and potassium and (r = 0.78) between the levels of nematode infestation. On the other hand, phosphorus levels and exposure to air pollutants (r = -0.30) and nematode infection (r = -0.14) show minimal relationships. Interestingly, there is a moderate positive association (r = 0.37) between the levels of air pollution exposure and nematode infection, suggesting that higher air pollution exposure may be associated with a higher vulnerability to nematode infestation in pulse crops. These results demonstrate the intricate interactions among environmental conditions, soil characteristics, and pulse crops' susceptibility to infestations by root knot nematodes.

4.2.objective 2

To analyze the physiological and biochemical responses of pulse crop plants to air pollutants, focusing on changes in root architecture, nutrient uptake efficiency, and defense mechanisms against root knot nematode infestations.

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Table 3: Physiological and Biochemical Response of different Pulse Crop Plants samples.

Sample ID	Air Pollutant Level (ug/m^3)	Root Architecture Change (cm)	Nutrient Uptake Efficiency (%)	Defense Mechanism Activity (Relative Units)
1	50	-1.2	78	0.85
2	30	-0.8	82	0.78
3	70	-1.5	75	0.92
4	45	-1	80	0.8
5	60	-1.3	77	0.88
6	25	-0.6	85	0.75
7	55	-1.1	79	0.83
8	65	-1.4	76	0.9
9	35	-0.9	83	0.76
10	40	-1	81	0.82

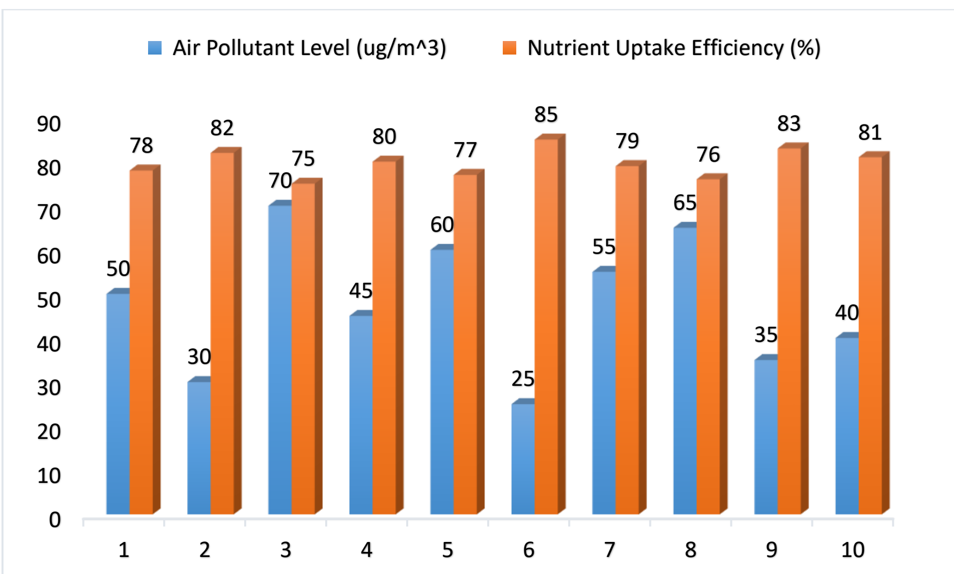

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Figure 1: Air Pollutant Level (ug/m^3) and Nutrient Uptake Efficiency (%) for different samples

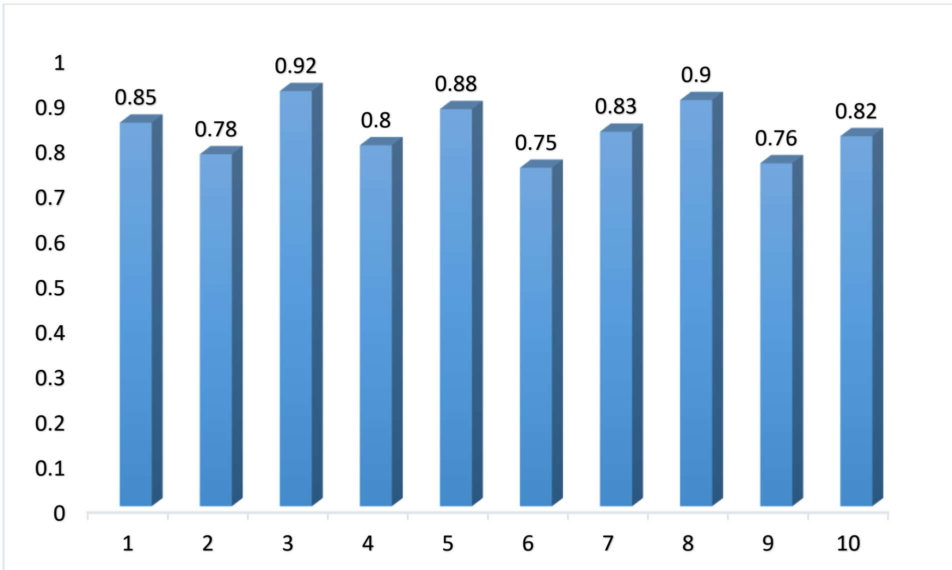

Figure 2: Defense Mechanism Activity (Relative Units) for different samples

Essential information about the physiological and biochemical alterations in pulse crop plants under different air pollution levels may be found in Table 3. With variations ranging from -0.6 cm to -1.5 cm, the data points to a consistent pattern of diminished root architecture and suggests a possible negative influence on the overall growth of the root system. Even though the range of observed nutrient uptake efficiency is 75% to 85%, most of the samples show a significant decrease in their ability to absorb nutrients when air pollution levels are high. Furthermore, the defence mechanisms' activity against infestations of root knot nematodes, as shown by relative units ranging from 0.75 to 0.92, suggests a possible association between elevated air pollution and weakened plant defence mechanisms.

5. CONCLUSION

Meloidogyne species, or root-knot nematodes Do members of one of the major plant parasitic nematode groups pose an increasing threat to vegetable growers? Since fumigant nematodes were phased out owing to health and environmental risks, the problem of root knot nematodes has only

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become worse and is now a significant obstacle to the successful cultivation of vegetables in both protected and open fields. According to the study, under different air pollution exposure levels, pulse crops' susceptibility to root knot nematode infestations is clearly influenced by the physicochemical properties of the soil, such as pH, organic matter content, and nutrient levels. Reduced pH and organic matter content may enhance susceptibility to nematode infections, according to the correlation study, which found strong relationships between soil pH, organic matter content, and nematode infestation levels.

REFERENCE

1. *Ardakani, A. S. (2013). Toxicity of silver, titanium and silicon nanoparticles on the root-knot nematode, Meloidogyne incognita, and growth parameters of tomato. Nematology 15 (6): 671-677*

2. *Bhat MY, Muddin H and Bhat NA. 2009. Histological interactions of Paecilomyees lilacinus and Meloidogyne incognita on bitter gourd. Journal of American Science, 5(1): 8-12*

3. *Bhat, M.Y., Fazal, M. and Hisamuddin (2009).Effect of Meloidogyne incognita race 1 on the functioning of rhizobial nodules on blackgram, Vigna mungo.Indian Journal of Nematology, 39: 59-64.*

4. *Cakmak, I. (2013). Magnesium in crop production, food quality and human health. Plant Soil 368: 1–4.*

5. *Chitwood, D. J. (2003). Research on plant‐parasitic nematode biology conducted by the United States Department of Agriculture–Agricultural Research Service. Pest Management Science: Formerly Pesticide Science 59 (6‐7): 748-753.*

6. *Damiani, I., Baldacci‐Cresp, F., Hopkins, J., Andrio, E., Balzergue, S., Lecomte, P., Puppo, A., Abad, P., Favery, B., and Hérouart, D. (2012). Plant genes involved in harbouring symbiotic rhizobia or pathogenic nematodes. New Phytologist 194 (2): 511-522.*

ISSN: 2320-3714
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September 2023
Impact Factor: 11.9
Subject: Botany

7. *Hureck, T., Handlley, L.L., Reinhold-Hurek, B. and Piche, Y. (2002). Azoarcus grass endophytes contributes fixed nitrogen to the plant in an unculturable state. Molecular Plant Microbe Interaction, 15: 233-242.*

8. *Shakeel, A., Khan, A. A., & Hakeem, K. R. (2020). Growth, biochemical, and antioxidant response of beetroot (Beta vulgaris L.) grown in fly ash-amended soil. SN Applied Sciences, 2(8), 1-9.*

9. *Shalizi, Z. (2007). Energy and emissions: local and global effects of the rise of China and India. World Bank Policy Research Working Paper, (4209).*

10. *Singh, K. (2011). Growth, yield and root-knot disease of pea plants under the stress of fly ash. In: Proceeding of National Conference on Recent Advances in Plant Sciences (Ed. Srivastava, P.), Department of Botany, D.S. College, Aligarh, BRA University, Agra (U.P.), India, pp. 107-113.*

11. *Teillet, A., Dybal, K., Kerry, B. R., Miller, A. J., Curtis, R. H., & Hedden, P. (2013). Transcriptional changes of the root-knot nematode Meloidogyne incognita in response to Arabidopsis thaliana root signals. PloS one, 8(4), e61259.*

12. *Tiwari, A. K., & Shivhare, A. K. (2016). Pulses in India: retrospect and prospects. Published by Director, Govt. of India, Ministry of Agri. & Farmers Welfare (DAC&FW), Directorate of Pulses Development, Vindhyachal Bhavan, Bhopal, MP.*

13. *Upadhyay, E. (2004). Impact of particulate air pollutants on Brassica juncea L. and Linum usitatissimiim L. Ph.D. Thesis. Aligarh Muslim University. Aligarh, India. pp. 173.*

14. *Verma, S. K., Singh, K., Gupta, A. K., Pandey, V. C., Trivedi, P., Verma, R. K., & Patra, D. D. (2014). Aromatic grasses for phytomanagement of coal fly ash hazards. Ecological Engineering, 73, 425-428.*

15. *Waliullah, M. I. S. (2005). Nematodes associated with kiwi (Actinidia deliceous Chev.) in Kashmir Valley, India. Indian Journal of Nematology, 35(2), 227.*

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