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Farmers' Perceptions, Knowledge and Practices for Nematode Management in Tomato Farms at Meghang, Nuwakot

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ABSTRACT

This study was carried out in Meghang Rural Municipality, Nuwakot, Nepal, to assess farmers' knowledge, perceptions, and practices regarding nematode management in tomato cultivation. The research was conducted from April 28 to June 20, 2025, covering the tomato cropping cycle to observe nematode symptoms, progression, and management outcomes. The Primary data were collected through field visits and semi-structured interviews using a simple random sampling method. A total of 100 tomato growers were selected across different wards. Findings revealed that 79% of farmers considered nematodes a growing problem, and average yield loss was reported to be 30%. Only 17% of farmers demonstrated high knowledge of nematode management. Traditional practices such as application of animal manure were most common (67%), while integrated pest management (IPM) was rarely practiced. Some farmers adopted crop rotation with onion, garlic, and legumes, common trap crops used by farmers was marigold, velvet been and rapeseed. A few used grafted seedlings as a management strategy. Field monitoring was weak, with less than 27% of farmers conducting regular inspections. Chemical control was widely adopted (88%), yet only 12% of farmers rated it as highly effective. Awareness of IPM was particularly low, with 80% reporting insufficient knowledge. Farmers have limited awareness and low adoption of sustainable nematode management practices. Capacity building, farmer training on IPM, promotion of resistant varieties and grafted seedlings, and improved access to non-chemical alternatives are urgently required. Strengthening institutional support can help minimize nematode related yield losses and improve tomato productivity.

Keywords: IPM, management practices, nematode infestation, yield loss

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INTRODUCTION

In Nepal, vegetables are considered a significant crop in terms of their food and economic value (Gurung *et al.,* 2016). In comparison to cereal crops, vegetables have higher rates of commercialization and a higher cost-benefit ratio (Rai *et al.,* 2019). Among different vegetables cultivated in Nepal, tomato (*Solanum lycopersicum*), are grown largely in a variety of environmental conditions. It is the second most important vegetable crop after potato in the world with the production of 186.12 million tons of fresh fruit in 4.92 million hectares of land and achieving average yield 37.84 tons per hectare (chaudhary,2024). Whereas in Nepal, tomato is ranked the third most commercially grown vegetable after cauliflower and cabbage which cultivated in total 22,911 hectares of land and produces annually 4,22,703 tons with an average productivity 18.45 ton per hectare (MoALD 2023). Tomatoes are susceptible to biotic and abiotic stress throughout their development stage (Adhikari & Shrestha,2020). Tomatoes are highly susceptible to a wide range of pests and diseases such as tomato leaf miner (Tuta absoluta), bacterial wilt (Ralstonia solanacearum), late blight (Phytophthora infestans), and root-knot nematodes (Meloidogyne spp.), which significantly reduce yield and quality (Sharma & Bhattarai,2021). Tomato plants can be susceptible to root-knot nematodes (Meloidogyne spp.), which are microscopic, roundworms that inhabit the soil. In presence of large population, they cause significant yield reduction (Baidya, 2013). Root-knot nematode in tomato is reported to cause yield reduction in a considerable amount world widely including the symptoms ranging from stunted growth, galled roots, chlorosis, wilting and eventually death of the host. Studies reported a 26.5 to 73.3 % reduction in yield in tomato due to root-knot nematode causing about $125 billion in annual losses world widely (Rawal, 2020). A nematode is the major biotic factor causing intolerable and uncontrolled stress which is also a reason for the low yield production in tomato (Ansari and Asif, 2016). In Nepal, nematode is reported from the districts such as Kathmandu, Bhaktapur, Lalitpur, Kavre, Chitwan, Dhankuta, Palpa and Jhapa suggesting 30% yield reduction in tomato cultivation in polyhouse (Rawal,2020).

MATERIALS AND METHODS

Study area

The study was conducted in the tomato growing region in Meghang rural municipality, Nuwakot District, Nepal. The area is characterized by mid-hill agroecology, where tomato cultivation is widespread as both subsistence and commercial farming.

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Sampling

A total of 100 tomato farmers were purposively selected using simple random sampling across five wards. Each ward contributed 15–25 respondents depending on the number of tomato growers.

Data collection

Primary data were obtained through structured questionnaires, semi structured interviews, and field observation. Questions focused on farmers' demographic profiles, perceptions of nematodes, knowledge of symptoms, and management practices adopted. The data entry and analysis were conducted using Microsoft excel. The primary data collected from the survey was entered and coded into a Microsoft excel sheet. The final data was analyzed and presented in the form of a bar diagram, pic charts, tables, and graphs using Microsoft excel.

RESULTS AND DISCUSSION

Years of tomato cultivated by respondents

From the survey, 44% of the respondents had been cultivating tomatoes for 5–10 years, making it the largest group.35% had experience ranging from 1–5 years, indicating a considerable proportion of moderately experienced farmers.8% of the respondents had been involved in tomato farming for less than 1 year, representing the least experienced group.13% had more than 10 years of experience in tomato cultivation.

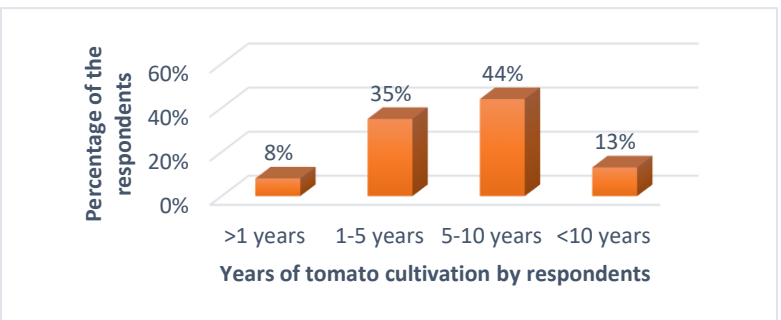

Figure 1. Years of tomato cultivated by respondents

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Seed source of the respondents

The seed source for most respondents, 82 percent, was nearby Agrovets, while 6 percent used self-preserved seeds. The remaining 7 percent obtained seeds from varietal trials, agricultural officers, and neighbors and remaining 5 percent was collected seeds from government offices . Most of the respondents used the sirjana varieties of tomato.

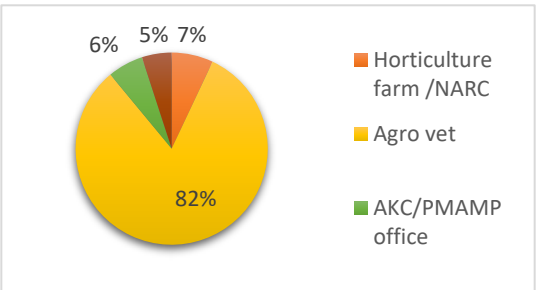

Figure 2. Seed source of the respondents

Methods of irrigation

The method of irrigation was categorized into four group i.e., manual, furrow, drip and rainfed irrigation. According to Figure 8, 25 percent of respondents used manual irrigation, while 48 percent had access to drip irrigation. 10 percent of the respondents relied solely on rainfall, without adopting any irrigation methods, and 17 percent used furrow irrigation. This study suggests that respondents was aware of the advantages of drip irrigation, which minimizes nutrient loss and reduces weed growth in fields.

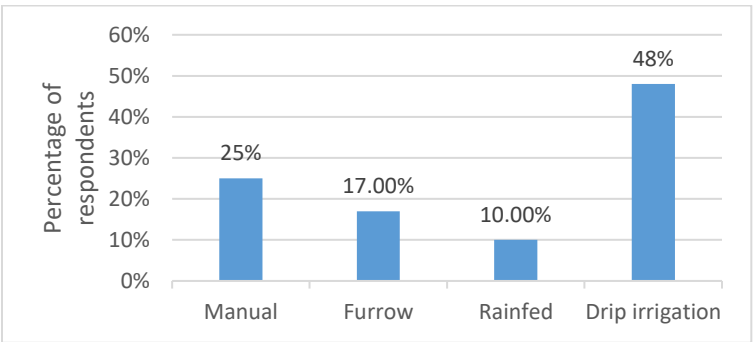

Figure 3. Methods of irrigation used by respondents

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Respondents get information on nematode identification and management

Respondents received information on nematode identification and management from various sources. About 40% of the respondents reported getting information from agrovets, 25% from neighbors and other farmers, 15% from other unspecified sources, 10% from mass media, and another 10% from Agricultural Knowledge Centers (AKC), Prime Minister Agriculture Modernization Project (PMAMP), or Farmer Field School (FFS) facilitators. The findings indicated that agrovets were the primary source of information on nematode identification and management for most respondents 40.

Respondents training on tomato cultivation and nematodes management

Respondents had received training related to tomato cultivation and nematode management from various sources. Among them, 44% were trained by other organizations, 24% through Farmer Field Schools (FFS), and 16% each from Agricultural Knowledge Centers (AKC) and the Prime Minister Agriculture Modernization Project (PMAMP). The findings revealed that 44% of the respondents received training from other organizations, which may have included NGOs, cooperatives, or private sector actors. Farmer Field Schools (FFS) accounted for 24% of the training sources, indicating their important role in hands-on, participatory learning approaches. Meanwhile, only 16% of the respondents were trained by AKC and another 16% by PMAMP, showing relatively limited involvement of government-led institutions in capacity building on tomato and nematode management.

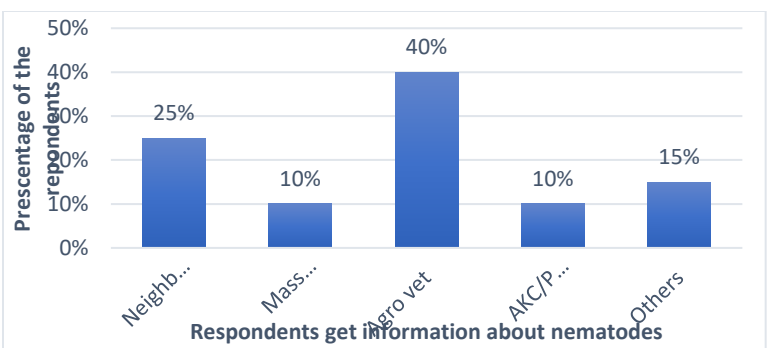

Figure 4. Respondents gets information about nematodes

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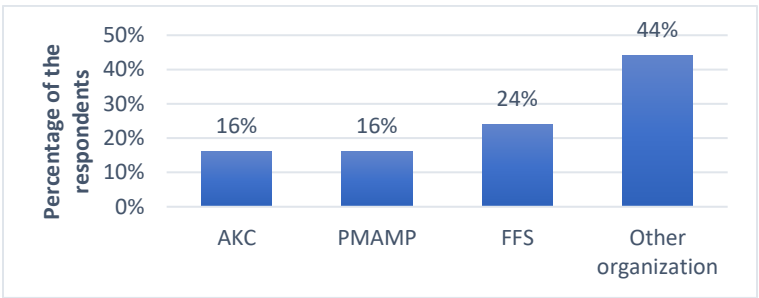

Figure 5. Training on tomato cultivation and nematodes management

Nematode infestation is a serious problem as compared to other pests In comparison to other pests, 27% of the respondents considered nematode infestation to be a very serious problem, 48% viewed it as somewhat serious, and 25% believed it was not a serious issue. The findings showed that nematodes were perceived as a significant pest problem by the respondents. A combined 75% of the farmers considered nematode infestation to be either very serious or somewhat serious, indicating a general awareness of the damage caused by nematodes in tomato cultivation. They found that while many farmers were aware of root-knot nematodes (RKN), knowledge about their biology, damage symptoms, and control was limited. For instance, some farmers misdiagnosed nematode damage as water stress or nutrient deficiency (Khanal et al.,2019).

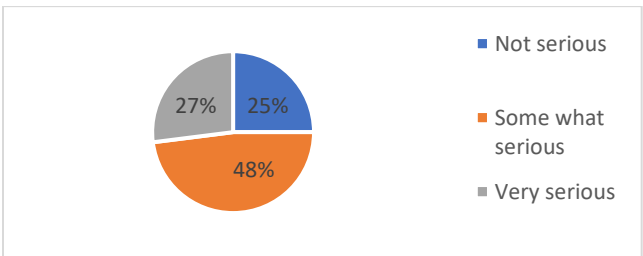

Figure 6. Nematode infestation is a serious problem as compared to other pests

Yield loss due to nematode infestation

Respondents reported varying levels of yield loss due to nematode infestation. About 38% experienced a yield loss between 10%- 30%, while 30% reported a loss of 30%-

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50% ,23% suffered less than 10% loss, and only 9% faced losses exceeding greater than 50% loss. Studies report ,In Nepal, farmers have reported losses mostly in the range of 10–30%, with some cases exceeding 50% under severe infestation (NARC, 2019). field study in Chitwan, Nepal, showed that root galling led to up to 40% reduction in fruit yield in tomato.

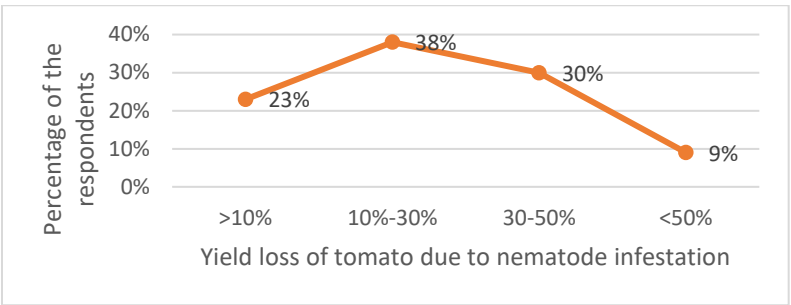

Figure 7. Yield loss due to nematode infestation

Knowledge of respondents about nematodes

Regarding knowledge about nematodes, 46% of the respondents were somewhat knowledgeable, 37% were not knowledgeable, and only 17% were very knowledgeable. The results showed that nearly half of the respondents 46% possessed some knowledge about nematodes, indicating a basic understanding of the pest and its effects. However, a substantial portion 37% lacked knowledge, which could hinder effective identification and management practices. Only 17% of respondents were very knowledgeable, likely due to access to training, experience, or extension services. A comparable study by **Nakarmi et al. (2025)** in central Nepal found that although farmers had heard of root-knot nematodes (Meloidogyne spp.), many confused nematode damages with nutrient deficiencies or drought stress, showing gaps in practical understanding (khanal *et al.,*2019).

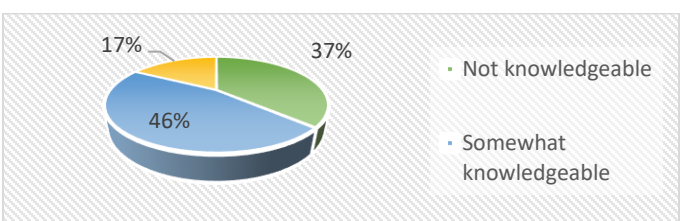

Figure 8. Knowledge of respondents about nematodes

Table 1. Practices adoption by farmers for nematode management

Management practices	Adoption by Farmers (%)
Crop rotation	Cowpea/Soybean–Tomato: 40% Onion/Garlic–Tomato: 38% Mustard–Tomato: 22%
Organic amendments	Animal manure: 67% Oil cake: 23% Compost: 12% Neem cake: 5%
Intercropping / Trap cropping	Mustard: 35% Marigold: 34% Cowpea: 17% Onion/Garlic/Radish: 14%
Grafted seedlings	15%

Cultural method adopted by farmers

The survey revealed diverse strategies employed by tomato farmers to manage nematode infestations. **Crop rotation** was common, with 40% practicing cowpea/soybean–tomato rotation, 38% onion/garlic–tomato, and 22% mustard–tomato. Leguminous crops suppress nematode populations, while alliums provide nematocidal compounds, and mustard acts as a biofumigant (Chitwood, 2002). Adoption of **resistant varieties** was negligible, as all farmers cultivated the 'Sirjana' variety despite awareness of resistance benefits. For **organic amendments**, 67% applied animal manure, followed by oil cake (23%), compost (12%), and neem cake (5%). Prior studies report neem and mustard oil cakes significantly reducing *Meloidogyne* spp. infestation (Khan et al., 2020; Bhat et al., 2021). **Intercropping/trap cropping** included mustard (35%), marigold (34%), cowpea (17%), and alliums or radish (14%). Marigold and mustard are recognized for nematode suppression through bioactive compounds (Hooks et al., 2010). Use of **grafted seedlings** was limited (15%), although grafting onto resistant rootstocks is proven to reduce nematode damage and enhance yield.

Biological / Botanical method

From the survey, Among the fungal biocontrol agents used by farmers for nematode management in tomato, the most commonly identified were *Trichoderma spp.* and *Purpureocillium lilacinum*. *Trichoderma spp*. are widely recognized for their antagonistic properties against a variety of soil-borne plant pathogens, including nematodes. *Purpureocillium lilacinum* is a specialized fungal biocontrol agent

effective against the egg and juvenile stages of root-knot nematodes (Khan *et al.,* 2020). The bacterial biological control agents commonly used for nematode management in tomato include *Bacillus subtilis* and *Pseudomonas fluorescens*. The strain *Bacillus subtilis* CRB7, when applied as a drench, reduced gall formation by up to ~ 85.8 % under protected cultivation, while increasing tomato yield by ~ 15–30 % in successive trials (Gowda et al., 2024). *Pseudomonas fluorescens* also acts as a biocontrol agent by producing antibiotics, siderophores, and hydrogen cyanide, which can suppress nematode activity. According to survey the respondents of Meghang used Various botanicals, such as neem (Azadirachta indica), marigold (Tagetes spp.), mustard (Brassica spp.), garlic (Allium sativum), and castor (Ricinus communis), which can inhibit nematode development, reduce egg hatching, and suppress population density.

Physical method

Among the physical control practices adopted by respondents, the most commonly reported method was soil drying 52%, followed by deep ploughing or tillage 44%. Only a small proportion of respondents 4% reported using flooding or waterlogging as a nematode management practice. Farmers practicing soil drying likely expose the infested soil to sunlight during fallow periods, which can help reduce nematode survival due to increased temperature and decreased moisture conditions unfavorable for nematode activity and reproduction. Deep tillage practice helps in exposing nematode eggs and juveniles to desiccation and predators and also disrupts their lifecycle by disturbing their habitat. Two rounds of deep summer ploughing reduced nematode infestation by 40–50% (Barker, 2013).

Chemical method

From the survey, A large majority of respondents 88% reported using chemical nematicides for managing nematodes in tomato fields, while only 12% indicated that they did not use any chemical nematicides. Commonly used nematicides in Nepal include products such as Nemazone, Carbofuran, and Ethoprophos, which target nematodes by disrupting their nervous systems or reducing egg hatch and mobility.

Name of chemical nematicides used by respondents

Respondents reported using several types of chemical nematicides in tomato fields to control nematodes. The use of these nematicides reflects the range of chemical options

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available to farmers in Nepal for managing nematodes. Ethoprophos (Nemazone) is a broad-spectrum organophosphate nematicide known for its effectiveness against nematodes and other soil pests. It acts as a contact and systemic poison. Fosthiazate (Nemathorin) is a systemic nematicide that offers both protective and curative action. It is effective when applied at transplanting and has shown strong activity against root-knot nematodes. Fluensulfone (Nimitz) is a newer generation, non-fumigant nematicide that has gained attention for its low toxicity profile and specificity to nematodes.

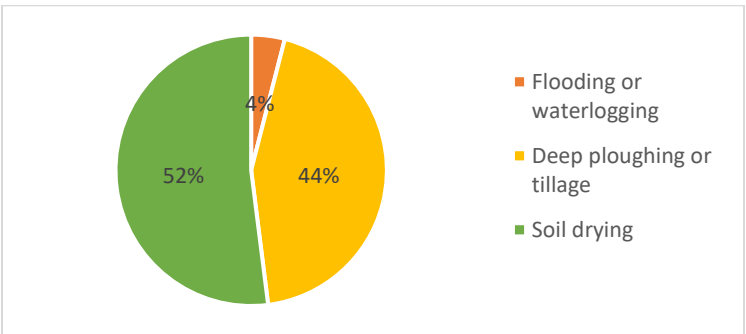

Figure 9. Physical control method used by respondents

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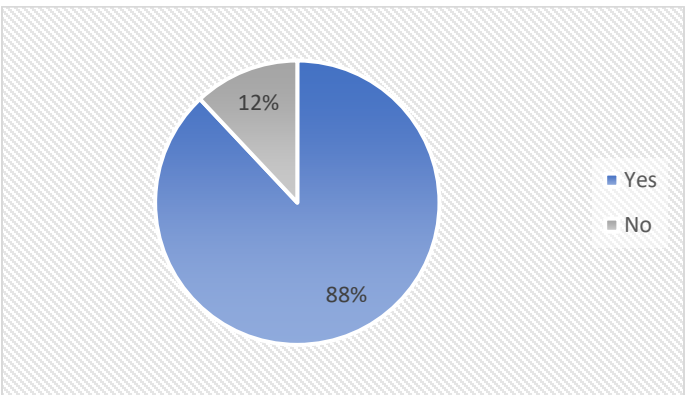

Figure 10. Chemical nematicides used by respondents

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Integrated pest management (IPM)

From the survey, only 20% of respondents reported receiving training or extension support on Integrated Pest Management (IPM) practices for nematode management in tomato cultivation, whereas a majority of 80% had not received any such support. The low percentage of farmers receiving training or extension services on IPM, a significant gap in knowledge transfer and capacity building in the study area.

Table 2. Benefits experienced by respondents when using IPM practices

S.N	Benefits
1	Long-term control
2	Improved soil health
3	Better yields
4	Safe for environment and human health
5	Reduced input cost

This ranking order flows from sustainability → soil foundation → yield outcome → safety → cost saving.

Table 3. Challenges faced by respondents while applying IPM method for nematodes control

S.N	Challenges faced by respondents
1	Limited Knowledge and Awareness about Nematodes and IPM Techniques
2	Lack of Technical Training and Practical Demonstration
3	Misdiagnosis of Nematode Symptoms
4	Inadequate availability of IPM inputs
5	Higher labor, time, and land requirements

This ranking flows from knowledge → skills → diagnosis → access → resource intensity.

CONCLUSION

The study identified root-knot nematodes as the most damaging pest affecting tomato production in Meghang, Nuwakot. Although farmers are aware of their impact, effective management practices remain limited, with heavy reliance on chemical nematicides such as ethoprophos, carbofuran, and nemathorin. The use of cultural, biological, and botanical methods such as crop rotation, neem, banmara, titepati, garlic extracts, and organic amendments is minimal. Limited awareness, inadequate training, and poor access to resources hinder the adoption of sustainable practices. Therefore, an integrated pest management (IPM) approach that combines chemical, cultural,

biological, and botanical strategies is essential. Strengthening farmer capacity, improving input access, and fostering collaboration among contributor can enhance sustainable tomato production and soil health in Meghang.

SUGGESTIONS

- Encourage the application of organic soil amendments like neem cake, mustard cake, animal manure, and compost to suppress nematode populations.
- Conduct targeted training and workshops on nematode identification, life cycle, symptoms, and management strategies, with emphasis on root-knot nematodes.

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