



# Compendium of the Genus *Quinisulcius* (Tylenchida: Telotylenchidae) and Observations on Occurrence of *Q. capitatus*

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## ABSTRACT

The compendium of *Quinisulcius* comprised of 17 species that based on the characters of the total body length, stylet, ratio of a, b, c, c', V%, head annules, tail annules, lip region and tail terminus. The allometric and morphometric characters were derived from the original descriptions. An up to date list of valid species of *Quinisulcius* along with illustrations and diagnostic key is provided. Detailed surveys of cereals, fruits and vegetables were conducted from district Hunza, Nager, Gilgit and Ghizer of Gilgit-Baltistan, Pakistan during 2014-2016 to determine the temperature dependent property of *Quinisulcius capitatus*. About 280 root and soil samples were taken from 47 locations and 28 agricultural crops. Compiled data from the world has shown that *Q. capitatus* has the potential to survive and propagate proficiently at low temperature (-2 to -15°C).

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## Authors' Contribution

SH conducted the surveys, collected the data and wrote the manuscript.

EI prepared the compendium and SF supervised the research.

## Key words

Compendium, *Quinisulcius capitatus*, Distribution, Gilgit-Baltistan.

## INTRODUCTION

In the order Tylenchida, *Quinisulcius*, Siddiqi, 1971 belongs to the subfamily Telotylenchinae, Siddiqi, 1960 of the family Telotylenchidae, Siddiqi 1960. This stunt nematode is plant parasitic and widely distributed in cold as well as warm climatic regions of the world. At present, 17 species are considered valid for this genus. The presence of lateral field marked by five incisures is the main diagnostic character of the genus among the family Telotylenchidae (Siddiqi, 2000). Among the genus, *Quinisulcius capitatus* species is mostly found in all over the world.

*Q. capitatus* was first described as *Tylenchorhynchus capitatus* by Allen (1955) from soil around the roots of pear orchard near Watsonville, California, USA. Later this species was synonymized with *Quinisulcius* by Siddiqi (1971). Maqbool (1982) described a new species *Quinisulcius solani* from root zone of potato at Murree, Rawalpindi, Pakistan. This species was synonymized with *Tylenchorhynchus* as *T. solani* by Fortuner and Luc (1987). Siddiqi (2000) placed this species under *Q. capitatus*. A new species *Q. quaidi* was described by Zarina and Maqbool (1992) from the roots of cotton, Karachi, Pakistan. In addition, four species of the genus *Quinisulcius* have so far been reported from Pakistan. Saeed *et al.* (1986) reported *Q. acutoides* (Thorne and Malek, 1968; Siddiqi, 1971) from soil around the roots of

tobacco (*Nicotiana tabacum*) from NWFP (now Khyber Pukhtunkhwa) and Punjab. Maqbool *et al.* (1983) and Maqbool (1984) reported *Q. acutus* (Allen, 1955; Siddiqi, 1971) and *Q. capitatus* from Murree hills around the roots of potato *Solanum tuberosum* as first records. *Q. curvus* was first reported by Akhtar (1962) around the roots of *Saccharum officinarum* from Punjab, Pakistan.

This species is characterized by the presence of cuticle finely annulated, five incisures in lateral field, cephalic region hemispherical, offset expanded, carrying 7-8 fine annules. Stylet 16-18 µm long with rounded knobs; excretory pore at the level of anterior end of terminal bulb. Vulva thick with small cuticular flaps. Spicules length more than anal body diameter. Bursa narrow with prominent rib-like phasmids. Female tail conoid, slightly curved bearing 30-50 annules with smooth terminus. Phasmids usually at the middle of tail.

*Quinisulcius* are ecto-parasitic in nature and can propagate easily below the temperature -2°C (Malek, 1980). In the previous reports *Q. capitatus* was considered of economic importance for the vineyards in the Cyprus (Raski *et al.*, 1973). It has frequency and population density of 50% and 8, respectively in beans, 50% and 2 in pepper, 25% and 3 in tomato and 33% and 4 in cabbage. They were suspected as pathogen for fruits and vegetables in Uganda (Bafokuzara, 1996). *Q. capitatus* has the host susceptibility for carrot, lettuce and tomato in the vegetables crops of Benin *i.e.*, 42.9% (Baimey *et al.*, 2009). *Q. capitatus* was identified and population from humid forest and Guinea Sannah from the Agro-ecological zones of Benin were defined. *Q. capitatus* has

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the prevalence 8.2%, relative abundance 0.6 and mean intensity 15.3 from the vegetables crops of Benin (Baimey *et al.*, 2009). *Q. capitatus* is the potential pest of potato growing areas in Himachal Pradesh, India. The range of *Q. capitatus* was found from 200-9620 nematodes per 200 g of soil in different samples of potato (Khan *et al.*, 1990). Khan *et al.* (1990) also presented the community analysis of the *Q. capitatus* with absolute frequency 52, relative frequency 24, absolute density 4820, relative density 38.6 and prominence value 18.9 from the potato growing area of Himachal Pradesh, India.

## MATERIALS AND METHODS

For compendium preparation data were collected from the original papers whereas line drawings are redrawn from the original ones. Measurements were taken with an ocular micrometer and also by tracing the outline of the structure on a paper with a drawing tube attached to

a compound microscope. Measurements were also taken from the drawing with a ruler or curvimeter for curved lines. Illustrations were made with the help of a drawing tube attached to the compound microscope. de Man (1884) formula was used for measurement of nematodes. Surveys were conducted during 2014-2016 for a comprehensive study of *Q. capitatus* from different districts of Gilgit-Baltistan. 280 samples were collected from 47 villages and 28 agricultural crops like cereal, fruits and vegetables.

## RESULTS AND DISCUSSION

A total of 17 species of the genus *Quinisulcius* have so far been reported by various scientists from different host plants and localities in Pakistan as well as other part of the world (Geraert, 2008). Detailed morphometric data and illustrations are included with following abbreviations: L, a, b, c, c', V, stylet, head annules, tail annules, lip region and tail terminus (Table I; Figs. 1, 2).

**Table I.- Compendium of the genus *Quinisulcius* Siddiqi, 1971.**

Nematode species	L (mm)	a	b	c	c'	V%	Stylet	Head annules	Tail annules	Lip region	Tail terminus
<i>Q. acutoides</i>	0.8	35	5.4	20	-	57	18	4-5	-	Offset	-
<i>Q. acutus</i>	0.65-	27.9-	4.8-	15.8-	2.2-	55.8-	16.0-	5.0-	15.0-	Slightly offset	-
	0.70	35.0	5.3	19.3	2.8	58.0	17.0	6.0	20.0	offset	-
<i>Q. brevistyletus</i>	-	-	-	-	3.2-3.6	-	12-13	-	63-74	Offset	-
<i>Q. cacti</i>	0.6-	25.0-	4-	14-	-	54.0-	15-	06	23	Slightly rounded	Without areolation
	0.70	33.0	6	19	-	59	19	-	-	rounded	areolation
<i>Q. capitatus</i>	0.68-	28-	4.8-	15-	2.1	54-	17-	6-	35-	Rounded setoff	Conical / rounded
	0.80	34	5.7	19	-	58	19	8	46	setoff	rounded
<i>Q. curvus</i>	0.47-	29-	4.5-	16-	3.1	51-	16-	4-	15-20	Setoff	Smooth pointed
	0.65	31	5.5	17	-	57	18	5	-	-	-
<i>Q. dulutensis</i>	-	-	-	-	-	-	21-23	-	-	-	-
<i>Q. domesticus</i>	0.59-	27-	4.8-	13-	2.5-	52-	15.5-	5-	20-	Offset	Blunt& Smooth
	0.75	29	5.9	15	3.1	59	17.6	6	22	-	Smooth
<i>Q. gumdariensis</i>	0.69-	29.5-	4.6	13.8-	2.25-	49.3-	13-	6-	46-	-	Smooth rounded
	0.89	36.0	-	17.9	3.50	57.9	18	7	52	-	rounded
<i>Q. indicus</i>	0.71-	32-	4.6-	16.4-	-	54-	15-	6	40-	Offset	Smooth
	0.8	37	5.8	18.3	-	60	18	-	46	-	-
<i>Q. lineatus</i>	0.81	41.0	-	18.0	3.1	57	16	-	42	Not off set	Smooth
<i>Q. obregonus</i>	0.47-	26-	4.7-	14-	2.0-	54-	12-	4-	19-	Offset	Smooth
	0.57	36	5.3	19	2.9	57	14	6	25	-	-
<i>Q. punici</i>	0.65-	32-	4.8-	15.2-	2.1-	50-	16-	6-	38-	Setoff	Smooth
	0.73	33	5.1	17.6	3.1	56.1	17	7	42	-	-
<i>Q. qaidi</i>	0.46-	25.8-	4.6-	14.3-	2.1-	52.7-	11.2-	6-	13-	Slightly offset	Slightly off set
	0.60	31.5	5.5	18.7	2.7	56.4	12.8	7	21	offset	off set
<i>Q. rotundicephalus</i>	0.50-	29.41-	4.69-	13.4-	2.66-	52.65-	14-15	4-	22-	Setoff rounded	Smooth
	0.56	32.74	5.44	18.3	3.58	56.6	-	5	23	-	-
<i>Q. seshadri</i>	0.72-	27.7-	5.8-	16.9-	2.3-	54.2-	15-	8-	37-	Slightly setoff	Smooth
	0.83	37.7	6.7	21.1	2.9	56.4	17	9	43	setoff	-
<i>Q. tarjani</i>	0.63-	30-	4.8-	11-	2.7-	54-	18-	5-	44-	Rounded setoff	Smooth
	0.78	32	6.3	15	3.7	55	19	7	60	-	-

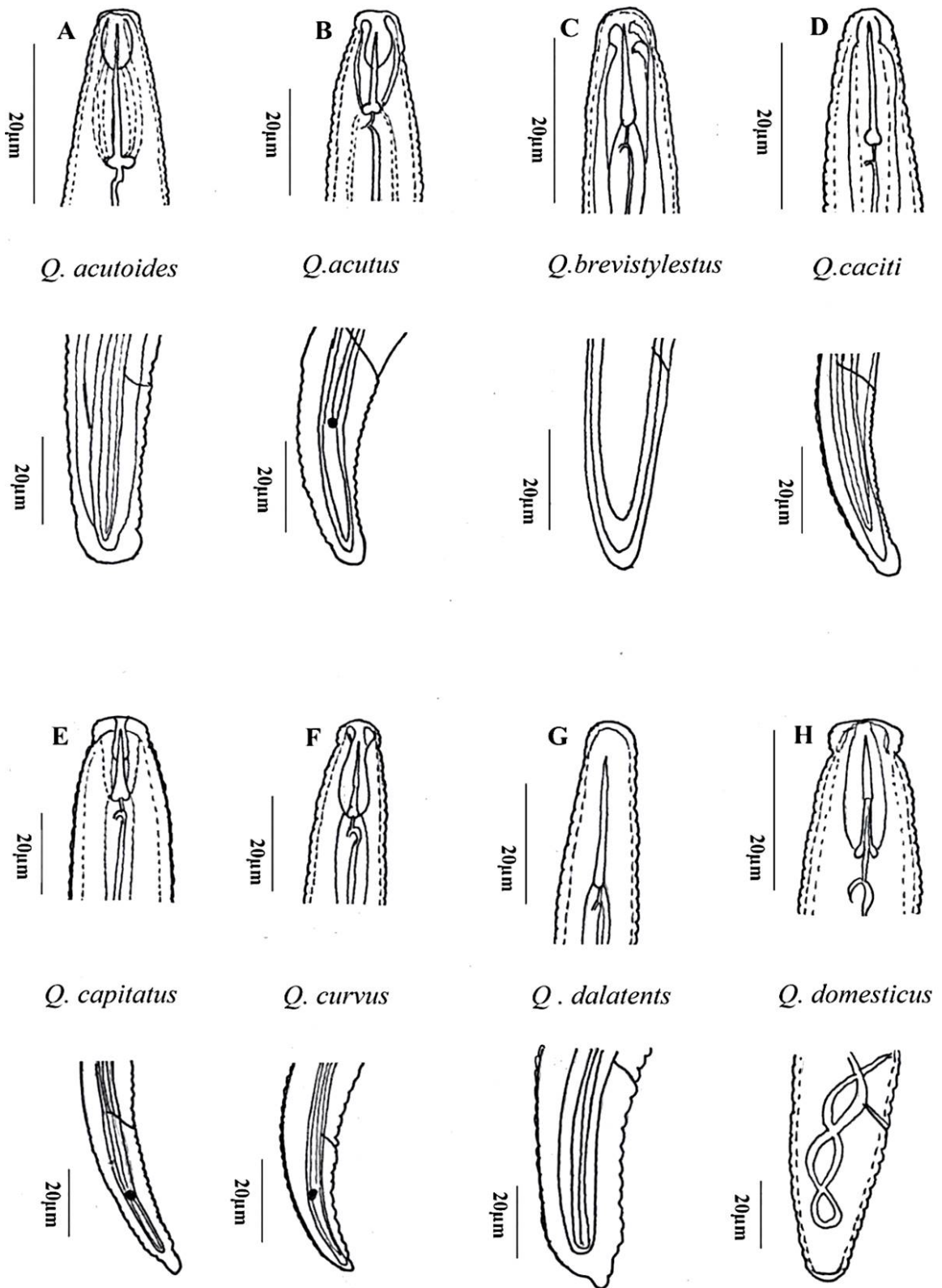


Fig. 1. Anterior and posterior regions of *Quinisulcius* species redrawn from original descriptions.

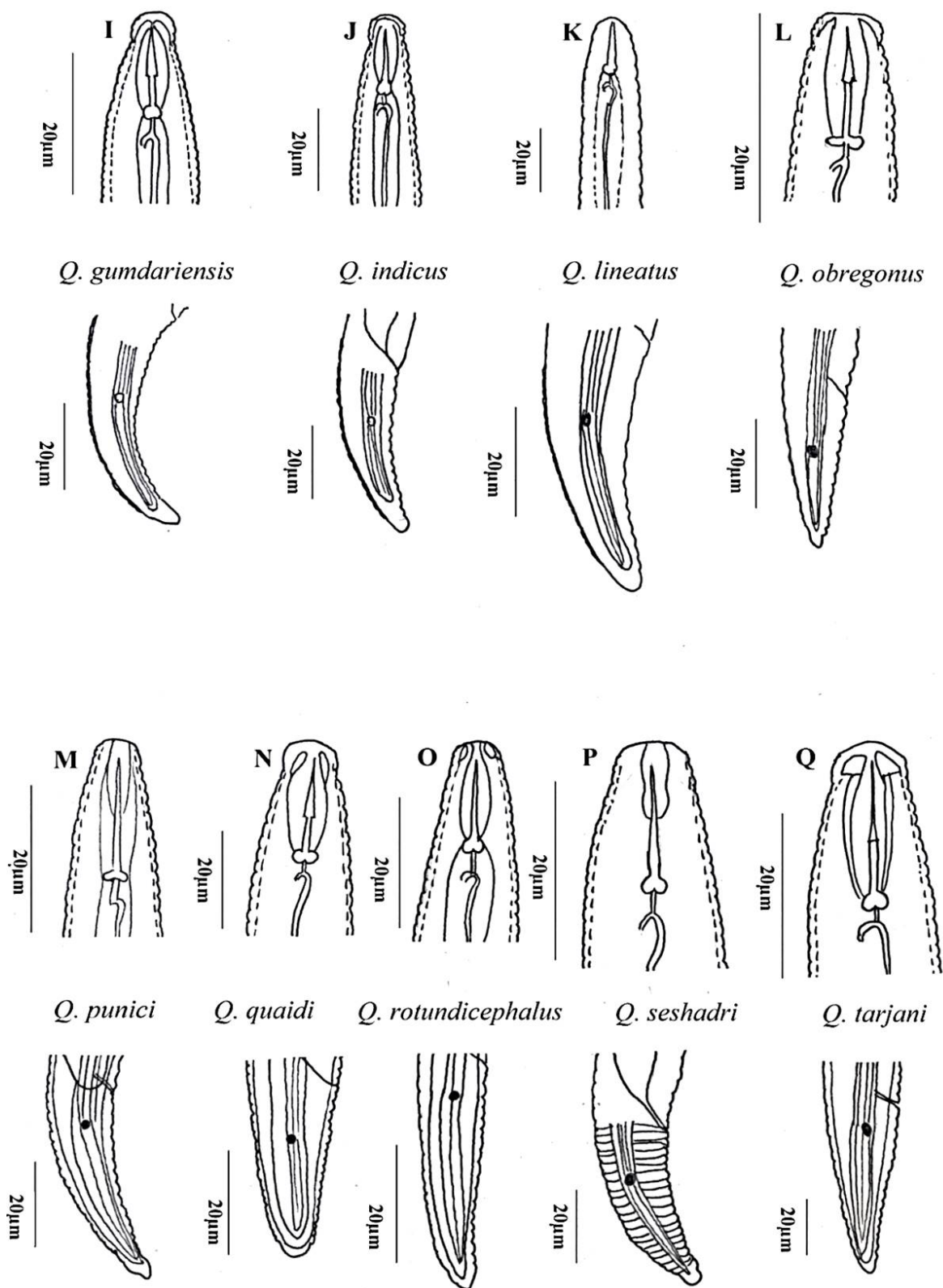


Fig. 2. Anterior and posterior regions of *Quinisulcius* species redrawn from original descriptions.

*Occurrence and distribution of Q. capitatus from Pakistan*

The occurrence and distribution of *Q. capitatus* was evaluated from 280 samples collected from the four districts of Gilgit-Baltistan viz., Hunza, Nager, Gilgit and Ghizer. A total of 47 villages were surveyed and 28 crop species were examined for the presence of *Q. capitatus*. Preliminary observations showed the presence of *Q. capitatus* in 250 out of 280 samples examined. The maximum positive samples were from District Nager (48%) where 21 plant species were surveyed and 18 (85.7%) were found infected

with *Q. capitatus*. From District Gilgit 10 out of 11 plant species were detected positive for the same nematode (90.9%).

Positive samples for *Q. capitatus* were 62.5% in Hunza, 100% in Ghizer. *Quinisulcius capitatus* was found with highest percentage in potato and maize fields of all the four districts. In addition to potato and maize, cherry and walnut crops also harbored high population of *Q. capitatus* from district Nager (Table II).

**Table II.- Occurrence % of *Quinisulcius capitatus* from different districts of Gilgit-Baltistan with respect to number of hosts.**

Localities	Latitude	Longitude	Elevation	Temp. (°C)	No. of hosts	<i>Q. capitatus</i> (+ samples)	Occur. %
District Hunza	36.3059 N	74.6259 E	2,500 M (8,200ft)	-2 to 26	08	05	62.5
District Ghizer	36.2666 N	74.7333 E	2,688 (8,822ft)	-14 to 35	02	02	100
District Gilgit	35.9201 N	74.3079 E	1,500 (4,900ft)	-10 to 46	11	10	90.9
District Nager	36.3593 N	73.3392 E	-		21	18	85.7

**Table III.- Occurrence of *Quinisulcius capitatus* from different areas of Pakistan.**

Location	Host	Climate (°C)	Latitude	Longitude	Reference
Bannu	Tomato, citrus	11.7-33.6	32°59' 11.99"N	70° 36' 11.99" E	Maqbool (1986); Maqbool and Shahina (1995)
Campbellpur	Potato	11-31.0	33°45' 38.99"N	72° 26' 1.00" E	Maqbool (1982)
Dadu	Fig, barley	8-44	26.7341°N,	67.7795° E	Maqbool (1986)
Faisalabad	Oat	5-40	31°25' 15.7620"	73° 5' 21.4584" E	Maqbool (1986)
Gujranwala	Maize, sugarcane	6-38	32.154377	74.184227E	Maqbool (1986, 1988)
Hazara	Maize, plum, pear	7-25	33°43' 59.99"N	72° 34' 59.99" E	Maqbool (1986)
Hyderabad	Maize	17-34	25°23' 32.71"N	68° 22' 25.18" E	Maqbool (1986)
Islamabad	Potato	9.8-31.7	33°44' 16.9620"N	73° 5' 4.1568" E	Maqbool (1982)
Khairpur	Melon		27°31' 47.8236"N	68° 45' 29.3076"E	Maqbool (1986)
Lahore	Oat, sweet citrus, sugarcane, maize	12.3-33.9	31°34' 55.3620"N	74° 19' 45.7536"E	Maqbool (1986, 1988); Maqbool <i>et al.</i> (1983)
Larkana	Potato, melon, maize	15-36	27°33' 50.38"N	68°12' 54.47"E	Maqbool (1982, 1986)
Mardan	Potato	5-30	4°12' 7.02"N	72° 03' 9.14" E	Maqbool (1982)
Mianwali	Oat	12-33	32°00' 0.00" N	71° 29' 59.99" E	Maqbool (1986)
Multan	Potato, mango, citrus	6-42	30°11' 44"N	71°28' 31" E	Maqbool (1982, 1986)
Muzaffargarh	Mango,	13 -35	30°04' 31.33"N	71° 11' 31.67" E	Maqbool (1986)
Nawabshah	Fig, barley	15 -35	26°14' 60.00"N	68° 24' 59.99" E	Maqbool (1986)
Palai, Malakand	Tomato	19.9-40	34°29' 59.99" N	71°44' 59.99" E	Maqbool and Shahina (1995)
Peshawar	Maize, plum, pear	12-32	34°00' 28.80"N	71° 34' 42.56" E	Maqbool (1986)
Quetta	Potato	5-30	30°11' 56.40"N	67° 00' 34.96" E	Maqbool (1982)
Rawalpindi	Potato	11-31	33°37' 33.8052"N	73° 4' 17.1912" E	Maqbool (1982)
Sahiwal	Potato, mango, citrus	13-35	30°40' 0.01"N	73° 05' 60.00" E	Maqbool (1982, 1986)
Sargodha	Potato, sweet citrus, citrus	12-33	32°05' 1.00"N	72° 40' 16.00" E	Maqbool (1982, 1986); Maqbool <i>et al.</i> (1983)
Sukkur	Potato, melon, fig , barley	15-36	27°42' 18"N	68°51' 26" E	Maqbool (1982, 1986)
Swat	Tomato	9-27	34°46' 25.1292"N	72° 21' 35.6436" E	Maqbool and Shahina (1995)
Thatta	Barley, maize, fig	18.2-32.4	24°44' 27.60"N	67° 55' 16.55" E	Maqbool (1986)

In district Ghizer five villages were surveyed, the highest population of *Quinisulcius capitatus* was found in village Hunder *i.e.*, 40% while the lowest population occurred in village Ghakuch *i.e.*, 13%. From district Gilgit the highest population of *Quinisulcius capitatus* was found in village Naltarbala *i.e.*, 19% while the lowest population occurred in village Danyore and Rahimabad *i.e.* 03%. In district Hunza, survey was performed from 15 villages, the highest population of *Q. capitatus* was found in village Khudabad *i.e.*, 19% while the lowest population occurred in village Ganish, Haiderabad and Ghulmit *i.e.*, 3%. In district Nager, the highest population of *Q. capitatus* was found from village Hoper *i.e.*, 18% while the lowest population *i.e.*, 2% occurred in nine villages Masoot, Ghulmat, Pissan, Askurdas, Shayar, Nilt, Sikanderabad, Chalt and Raabat.

The selected host species from district Hunza were potato (*Solanum tuberosum*), maize (*Zea mays*), apple (*Pyrus malus*), peach (*Prunus persica*) and cherries (*Prunus avium*). From district Nager potato (*Solanum tuberosum*), chilies (*Capsicum annuum*), maize (*Zea mays*), onion (*Allium cepa*), apricot (*Prunus armeniaca*), walnuts (*Juglans* spp.), cherries (*Prunus avium*), plum (*Prunus domestica*), faiz (*Elaeagnus* sp.), pomegranate (*Punica granatum*), peach (*Prunus persica*), peas (*Pisum sativum*), apple (*Pyrus malus*), pear (*Pyrus communis*),

grape (*Vitis vinifera*), almond (*Prunus amygdalus*) were tested. From District Gilgit potato (*Solanum tuberosum*), carrot (*Daucus carota*), maize (*Zea mays*), cucumber (*Cucumis sativus*), chilies (*Capsicum annuum*), tomato (*Lycopersicon esculentum*), peach (*Prunus persica*), apricot (*Prunus armeniaca*), cabbage (*Brassica oleracea* var. *capitata*), cherries (*Prunus avium*) were surveyed while from District Ghizer potato (*Solanum tuberosum*) and maize (*Zea mays*) were selected.

The record of *Q. capitatus* % occurrence has been compiled along with the hosts from different localities of Pakistan (Table III) as well as other parts of the world (Table IV).

During research different plant parasitic nematodes has been identified up to species level from Gilgit-Baltistan but the population occurrence and distribution of *Quinisulcius capitatus* has found abundantly in all the surveillance areas. It may be a future threat to Gilgit-Baltistan based on high frequency of occurrence. *Q. capitatus* may be causing damage to these crops because it is potential pest to other crops in cold climate regions of the world. According to research of different scientists from time to time it was observed that it required low temperature for its reproduction and increases the population at 20°C. It can be survived below freezing point (Table III).

**Table IV.- Occurrence of *Quinisulcius capitatus* from different areas of the world.**

Location	Host	Climate (°C)	Latitude	Longitude	Reference
Blountsville, USA	Okra	17	34.0815N°	86.5911W°	Hopper (1959)
Chiavari, Italy	Date palm	10-14	44.3168N°	93.2224E°	Loof (1959)
Shimla Hills, India	Apple, citrus, plum	-4-31	31.1048N°	77.13E°	Swarup <i>et al.</i> (1964)
Tamil Nadu, India	Cabbage	20-35	8.740818	77.795265	Seshadri <i>et al.</i> (1967)
Moldova, USSR	Solanaceous crops	-4-20	28.55E°	47.0002 N°	Dement'ev (1971)
Isla Aguada Campeche	Grass	14-35	18.7843N°	91.4918W°	
Hermosillo, Singapore	Pasture grass and wild pappy	17-31	20.1060 N°	11057W°	Knobloch and Laughlin (1973)
Las Machis, Sin	Barrel cactus	2.5-35	25.4728 N°	10859W°	
Istanbul, Turkey	Tomato, pepper, bean, potato	6-24	41.0082N°	28.9784E°	Saltukoglu and Coomans (1975)
Oaxaca city, Mexico	Bamboo	0-40	17.3339N°	96.4317W°	
Galiccia and Cantabria, Spain	Sugar beet	7-18	42.5751N°	8.13339W°	Arias and Romera (1975)
Uzbekistan	Quince and Oleater	-2-40	41.3775N°	64.5853E°	Turaev and Khurramov (1981)
Mexican Altiplano	Maize	3-18	24.000N°	102.000W°	Vazquez (1976)
Ecuador	Tomato, soybean, sugarcane	10- 25	1.8312S°	78.1834W°	Bridge (1976)
Basin of River Mesta, Bulgaria	Tobacco	-5 -30	42.7339N°	25.4858E°	Katalen <i>et al.</i> (1978)
Limassol, Nicosia, Larnaca, Cyprus	Vineyard	12- 26	34.7071N°	33.02261E°	Antoniou (1981)

*Statement of conflict of interest*

The authors have no conflict of interest to declare.

## REFERENCES

- Akhtar, S.A., 1962. Free-living nematodes inhabiting Lahore soil. *Agric. Pakistan*, **13**: 64-80.
- Allen, M.W., 1955. A review of the nematode genus *Tylenchorhynchus*. *Univ. Calif. Publ. Zool.*, **61**: 129-166.
- Antoniou, M., 1981. A nematological survey of vineyards in Cyprus. *Nematol. Mediterr.*, **9**: 133-137.
- Arias, M. and Romera, M.D., 1975. *Boln R. Soc esp. Hist. Nat. (Vol. Extraordinario del 1 Centenario 1871-1971)*.
- Bafokuzara, N.D., 1996. Incidence of different nematodes on vegetable and fruit crops and preliminary assessment of yield loss due to *Meloidogyne* species in Uganda. *Nematol. Brasil.*, **20**: 32-43.
- Baimey, H., Coyne, D., Dagbenonbakin, G. and James, B., 2009. Plant parasitic nematode associated with vegetable crops in Benin: Relationship with soil physico-chemical properties. *Nematol. Mediterr.*, **37**: 227-236.
- Bridge, J., 1976. Plant parasitic nematodes from the low land and high land of Ecuador. *Nematropica*, **6**: 18-23.
- Dement'ev, S.P., 1971. *Parazity zhivotnykh I rostenii. Kishinev, izdatel'stvo shtiintsa*, **7**: 139-142.
- de Man, J.G., 1884. *Die frei in der reinen Erde und im sussen wasser lebenden Nematoden der Niederlandischen Fauna. Eine Systemat. Faun. Monogr.* E. J. Brill, Leiden, pp. 1-206. <https://doi.org/10.5962/bhl.title.46884>
- Fortuner, R. and Luc, M., 1987. A reappraisal of Tylenchina (Nemata) 6. The family Belonolaimidae Whitehead 1960. *Rev. Nematol.*, **10**: 183-202.
- Geraert, E., 2008. *The Tylenchidae of the world: Identification of the family Tylenchidae (Nematoda)*. Academia Press, Gent, Belgium, pp. 540.
- Hopper, B.E., 1959. Three new species of the genus *Tylenchorhynchus* (Nematoda: Tylenchida). *Nematology*, **4**: 23-30. <https://doi.org/10.1163/187529259X00336>
- Katalan-Gateva, S.H. and Baicheva, O., 1978. The nematode fauna of tobacco Oriental-261 in the Blagoevgrad region II. *Khel'mintologiya Sofia*, **5**: 47-59.
- Khan, E. Ganguly, S. and Lalitha, Y., 1990. *Quinisulcius capitatus* a potential pest of potato in Himachal Pradesh, India. *Int. Nematol. Network Newsl.*, **7**: 22-24.
- Knobloch, N.A. and Laughlin C.W., 1973. A collection of plant parasitic nematodes (Nematoda) from Mexico with description of three new species. *Nematology*, **19**: 205-217. <https://doi.org/10.1163/187529273X00330>
- Loof, P.A.A., 1959. Miscellaneous notes on the genus *Tylenchorhynchus* (Tylenchinae: Nematoda). *Nematology*, **4**: 294-306. <https://doi.org/10.1163/187529259X00507>
- Malek, R.B., 1980. Population response to temperature in the subfamily Tylenchorhynchinae. *J. Nematol.*, **12**: 1-6.
- Maqbool, M.A., 1982. Description of *Quinisulcius solani* n. sp., (Nematoda: Tylenchorhynchidae) with a key to the species and data on *Scutylenchus koreanus* from Pakistan. *J. Nematol.*, **14**: 221-225.
- Maqbool, M.A., Fatima, N. and Hashmi, S., 1983. *Merlinius niazae* n. sp. (Nematoda: Merliniinae) and the occurrence of some members of Merliniinae and Tylenchorhynchinae in Pakistan. *Pak. J. Nematol.*, **1**: 111-121.
- Maqbool, M.A., 1984. *Studies on plant parasitic nematodes of cereals and fruit of Pakistan with special reference to Quinisulcius solani Maqbool, 1982*. Ph. D thesis, Department of Botany, University of Karachi, Karachi, Pakistan, pp. 190.
- Maqbool, M.A., 1986. *Classification and distribution of plant parasitic nematodes in Pakistan*. NNRC, University of Karachi, Karachi, pp. 58.
- Maqbool, M.A., 1988. An overview of nematode problem and research in Pakistan. In: *Advances in plant nematology*. Proc. US-Pak. Int. Workshop on Plant Nematology, NNRC, University of Karachi, pp. 23-46.
- Maqbool, M.A. and Shahina, F., 1995. Plant parasitic nematodes associated with fruits and vegetables in Malakand agency, Pakistan. *Pak. J. Nematol.*, **13**: 83-92.
- Raski, D.J., Hart, W.H. and Kasimatis, A.N., 1973. *Nematodes and their control in vineyards*. California Agriculture Experimental Station Service Circle, pp. 20.
- Saeed, M., Khan, H.A., Khan, S.A. and Qamar, F., 1986. A survey of the nematode problem of tobacco in Pakistan (A) nurseries. *Pak. J. scient. indust. Res.*, **29**: 279-283.
- Saltukoglu, M.E. and Coomans, A., 1975. The identity of *Quinisulcius acti* with *Q. capitatus* (Nematoda: Dolichodoridae). *Meded. Fak. Land Wet.*, **40**: 497-500.

- Seshadri, A.R., Muthukrishnan, T.S. and Shanmugam, S., 1967. A new species of *Tylenchorhynchus* in Madras State. *Curr. Sci.*, **36**: 551-553.
- Siddiqi, M.R., 1960. *Telotylenchus* a new nematode genus from North India (Tylenchida: Telotylenchinae n. sub-family). *Nematology*, **5**: 73-77. <https://doi.org/10.1163/187529260X00424>
- Siddiqi, M.R., 1961. Studies on *Tylenchorhynchus* spp. (Nematoda: Tylenchida) from India. *Z. Parasitenk.*, **21**: 46-64. <https://doi.org/10.1007/BF00260176>
- Siddiqi, M.R., 1971. Structure of the oesophagus in the classification of the superfamily Tylenchoidea (Nematoda). *Ind. J. Nematol.*, **1**: 25-43.
- Siddiqi, M. R., 2000. *Tylenchida parasites of plants and insects*, 2<sup>nd</sup> edition. CABI Publishing, Wallingford, UK, pp. 833. <https://doi.org/10.1079/9780851992020.0000>
- Swarup, G., Sethi, C.L. and Gill, J.S., 1964. Some records of plant parasitic nematodes in India. *Curr. Sci.*, **33**: 593.
- Thorne, G. and Malek, R.B., 1968. Nematodes of the Northern Great Plains. Part 1. Tylenchida (Nemata: Secernentea). *Tech. Bull. S. Dakota Agric. Stat.*, **31**: 1-11.
- Turaev, E.T. and Khurramov, S.K., 1981. Parasitic nematodes of weeds and of the apple rhizospheres of the Surkhandarinsk region (USSR). *Uzbek. Biol. Z.*, **1**: 56-60.
- Vazquez, J.T., 1976. *Infestaciones de nematodes fitoparasitos como factor limitante on la production de maiz en al altiplano Mexicano*. Produccion del Departamento Mexicano, CADAGEM, pp. 79.
- Zarina, B. and Maqbool, M.A., 1992. Description of *Quinisulcius quaidi* n. sp., and additional morphometries of two known species of Tylenchorhynchinae (Nematoda: Dolichodoridae) from Pakistan. *Pak. J. Nematol.*, **10**: 7-13.