The Pharma Innovation Journal 2021; 10(9): 531-535

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(9): 531-535

www.thepharmajournal.com
Received: 13-07-2021
Accepted: 15-08-2021

TC Yadav
Department of Nematology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

BL Baheti
Department of Nematology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

Corresponding Author:
TC Yadav
Department of Nematology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, Indi

Effect of botanicals as seed and soil treatment against cereal cyst nematode, *Heterodera avenae* infecting wheat (*Triticum asetivum* L.)

TC Yadav and BL Baheti

Abstract
Wheat (*Triticum aestivum* L.) widely cultivated cereal crop and used as staple food world over. It is a good source of multiple nutrients and dietary fiber. However, due to number of biotic and abiotic stress, its productivity is being low. Biotic stress (Insect-pest, pathogens and nematodes) play an important role in reducing production and productivity of wheat. Among plant parasitic nematodes, problem of cereal cyst nematode, *H. avenae* on wheat has been increase day by day due to favourable agro-ecological conditions. Looking to the importance of cereal cyst nematode, *Heterodera avenae*, numbers of attempts have been made to studies on various aspects of *H. avenae* on wheat but still eco-friendly management options for this nematode on wheat is lacking. Therefore, to fill this gap of knowledge, present investigation was conducted to find out eco-friendly management of *Hetrodera avenae* on wheat. Under the trial, efficacy of dry leaves powder of problematic weeds *i.e.* Gajar grass (*Parthenium hysterophorus*), Lantana (*Lantana camara*) and Amaranthus (*Amaranthus viridis*) at 1% and 2% as seed treatment (ST) and 1g & 2g as soil application (SA) were tested for the management of cereal cyst nematode, *Heterodera avenae* on wheat. A standard check (Neem leaves powder at 2% as ST + 2 g/pot as SA) and untreated check was also maintained to interpretate experimental findings. Results exhibited that neem leaves powder at 2 % ST + 2 g/pot as SA was found most effective followed by Amaranthus at 1 % ST + 2 g/pot SA and Amaranthus 2 % ST + 1 g/pot SA to increase the plant growth parameters of wheat and to decrease the infection of cereal cyst nematode, *H. avenae*.

Keywords: *H. avenae*, wheat, gajar grass, lantana, amaranthus, nematode management

Introduction
Wheat (*Triticum aestivum* L.) is widely cultivated cereal crop and used as staple food world over. Globally, wheat is cultivated in 220.10 million hectares area and 763.06 million tones production. India ranks second after China in the production of wheat. Wheat is one of the most important cereal crop being grown extensively in tropical and subtropical conditions of Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, Haryana, Bihar, Chhattisgarh, Jharkhand, Maharashtra, Delhi, Gujarat and Himachal Pradesh. At present about 102.19 million tones of wheat are produced from an area of 29.14 million hectares of area in India. Rajasthan contributes 10.49 million tones of production with 3.00 million hectares or area (Agriculture Statistics at a Glance, 2018) [2]. Recently as per 3rd advance estimates, the estimated production of wheat during 2020-21 is 108.75 million tonnes in India. It is mainly grown in Sri Ganganagar, Hanumangarh, Kota, Banswara, Udaipur, Baran, Bundi, Sawai Madhopur, Jaipur, Bharatpur, Dholpur, Karauli, Pali, Sirohi, Chittorgarh, Rajsamand, Jhalawar, Dungarpur and Bhilwara districts of Rajasthan.

Globally, it is the leading sources of vegetable protein in human food, having a protein content of about 13% which is relatively high compared to other cereals but relatively low in protein quality for supplying essential amino acids. Wheat is a good source of multiple nutrients and dietary fiber. This is attacked by several insect-pest, pathogens and nematodes (*Heterodera avenae*, *Anguina tritici*, *Pratylenchus*, *Tylenchorhynchus*, *Meloidogyne tritichorhizae*, *Hoplolaimus*, *Helicotylenchus*, *Longidorus*, *Trichodorus*, *Xiphinema* and *Belonolaimus*). Among nematodes, cereal cyst nematode, *Heterodera avenae* and seed gall nematode, *Anguina tritici* are the most important nematode pest of wheat. Due to clean cultivation and use of certified seeds, presently the problem of *Anguina tritici* drastically reduced and has being negligible. However, the problem of cereal cyst nematode, *H. avenae* has been increase day by day due to favourable agro-ecological conditions.

Cereal cyst nematode was recorded on wheat for the first time from Germany by Kuhn (1874) [6]. In India, it was first reported from "Neem Ka Thana" village of Sikar district of Rajasthan on roots of wheat (Vasudeva, 1958) [17]. Prasad *et al.*, (1959) [11] reported 'Molya' as a serious disease which is responsible for losses to the crop annually and no grain formation takes place in wheat under heavily infested fields. Swarup and Singh (1961) [16] observed that 'Molya' disease causes heavy annual losses to wheat. They reported more than 50 per cent of crop is loss due to this nematode disease. Mathur (1969) [7] studies the crop losses in wheat due to *H. avenae*. He observed a total loss of yield in severely infested fields. Van Berkum and Seshadri (1970) [18] estimated that *Heterodera avenae* alone causes a loss of Rs. six crores annually in the state of Rajasthan alone. Koshy and Swarup (1971) [5] reported wide distribution of *Heterodera avenae* on wheat in India. Looking to the economic importance of *Heterodera avenae* on wheat, the present investigation was conducted to find out eco-friendly management option of the nematode.

Material and Methods

An experiment was conducted to test of the efficacy of plant dry leaves powder *i.e.* Gajar grass (*Parthenium hysterophorous*), Lantana (*Lanatana camara*), Amaranthus (*Amaranthus viridis*) at 1% and 2% w/w as seed treatment coupled with 1 and 2 g/pot as soil application for the management of cereal cyst nematode, *Heterodera avenae* on wheat. Neem leaves powder at 2% w/w as seed treatment alongwith 2 g /pot as soil application kept as treated standard check and an untreated check was also maintained to interpretate the experimental results. Weighed quantity of seeds for each treatment was taken in a plastic beaker and few drops of gum added to it and stirred with the help of wooden rod. Thereafter, required quantity of botanical was added to it and mix well to provide uniform coating over seeds. Fine chalk powder was applied as drying agent for the treated seeds. The experiment was laid out in completely randomized design with four replications. Full care was taken right from sowing till harvest of experiment for proper growth and development of plants. For soil application, the required quantity was weighed separately for each experimental pot and mixed well in soil at the time of sowing. Soil sample was collected and processed to determine initial population of nematode before sowing. It was recorded 8 cyst/200 cc soil. The experiment was harvested after ninety days of sowing and observations on shoot length (cm), shoot weight (g), numbers of females per plant, number of cysts per 200 cc soil and number of juveniles per 200 cc soil were recorded, analyzed, presented in Table-1 and illustrated through Figure 1-2.

Results and Discussions

Limitation in controlling plant parasitic nematode through chemicals and other methods necessitated search for botanicals to decrease the nematode population. Botanicals products are economical, effective and environmentally safe for human beings and domestic animals as well as to manage plant parasitic nematode in agricultural crops. Recently, plant products have been proved to be the best for nematode management alone as well as in combination with other methods of nematode management options. Looking to the advantages, an experiment was carried to find out suitable botanical leaves as seed and soil treatment for the management of cereal cyst nematode, *Heterodera avenae* on wheat.

Results exhibited that application of dry leaves powder of neem, gajar grass, lantana and amaranthus increased shoot length (cm) and shoot weight (g) of wheat infested with *H. avenae* when applied as seed and soil treatment. Among various leaves powders, highest shoot length (79.75 cm) was recorded when neem leaves powder when applied as 2 per cent seed treatment (ST) + 2 g/pot as soil application (SA) followed by amaranthus 1 % ST + 2 g/pot SA (78.12 cm) and amaranthus 2 % ST + 1 g/pot SA (67.45 cm). These treatments significantly enhanced shoot length over rest of the treatments (Table-1). Lowest shoot length (51.80 cm) was recorded with gajar grass when applied at 2 % ST + 1 g/pot SA but found significantly better over untreated check. Results illustrated through Fig-1 revealed that maximum increase in shoot length (66.94 %) with the application of neem leaves at 2 % ST + 2 g SA followed by amaranthus at 1 % seed treatment + 2 g SA (61.44 %) and amaranthus at 2 % seed treatment + 1 g/pot SA (48.88 %) over untreated check. It was recorded to be minimum (8.43 %) with Gajar grass when applied as 2 % ST + 1 g/pot SA. Almost similar trend was noticed with respect to shoot weight.

Findings of present investigation are in accordance with previous workers who obtained that seed treatment with botanicals increased plant growth in nematode infested areas. Parvathareddy *et. al.*, (1993) [10] applied chopped leaves of neem, lantana, *Calotropis*, castor, marigold, *Parthenium*, sesamum and periwinkle each at 100g / 2 kg infested soil against *M. incognita* on papaya *cv*. Coorg Honey Dew and observed that castor and neem leaves gave highest shoot length and shoot weight. Similarly Sharma *et al* in 1996 [14], Ram and Baheti in 2004 [13] reported the effect of botanicals against root-knot nematode, *Meloidogyne incognita* on tomato and reniform nematode, *Rotylenchulus reniformis* on cowpea, respectively. Rajvanshi and Bisnoi (2012) [12] found that yield of wheat was maximum with Carbosulfan treatment followed by the neem seed kernel powder, neemark and neem oil as compared to farmers practice. Mehta *et al.*, (2015) [9] observed maximum increase in plant growth parameters with neem (*Azadirachta indica*) leaves powder at 4 g/plant followed by aak (*Calotropis procera*) and water hyacinth (*Eichornia crassipes*) leaves powder at 4 g/plant over control on maize infested with *H. zeae*. Similar results have also been reported by Baheti *et al.* (2015) [3] on sweet corn.

These findings expressed that application of plant leaves powder as seed and soil application enhanced plant growth in nematode prone areas. This may be due to the reason that seed and soil application with plant products improved physical condition of soil, reduce population of plant parasitic nematodes and enhances the activity of beneficial soil microbes.

Results revealed that seed and soil treatment with leaves powder of gajar grass (*Parthenium hystrophorous*), lantana (*Lantana camara*) and amaranthus (*Amaranthus viridis)* at 1% and 2% w/w as seed treatment with 1 and 2 g/pot as soil application effectively reduced the infection of *H.avenae* on wheat. These treatments significantly decreased number of females per plant, number of cysts per 200 cc soil and number of juveniles per 200 cc soil of *H. avenae* on wheat (Table-1). Among different treatments, minimum number of females per plant (11.00) was recorded with neem leaves powder at 2 % ST + 2 g/pot SA followed by amaranthus at 1 % ST + 2 g/pot SA (17.25) and amaranthus at 2 % ST + 1 g/pot SA (20.50).

Highest number of females per plant (28.00) was recorded in untreated check followed by gajar grass (25.00) at 2 % ST + 1 g/pot SA and Lantana (24.25) at 2 % ST + 1 g/pot SA. Maximum reduction (46.92 %) in numbers of females per plant obtained with neem leaves powder at 2 % ST + 2 g/pot SA followed by amaranthus 1% ST + 2g/pot SA (43.07 %) and amaranthus at 2 % ST + 1g/pot SA (40.00 %). Minimum reduction (16.15 %) was recorded with gajar grass when applied at 2 % ST + 1 g/pot SA. Similar trend was recorded with regards to number of cyst and nematode juveniles per 200 cc soil (Fig.-2).

Results of present investigation are in accordance with the findings of earlier workers. Akhtar and Alam (1989) [1] reported that incorporation of chopped leaves of *Azadirachta indica* (neem) *Lantana camara, Calotropis procera, Eucalypts citrodera* etc. at 50 or 100 g/pots significantly suppressed buildup of *Hoplolaimus indicus, Helicotylencus indicus, Tylencorhynchus brassicae, Rotylenchulus reniformis* on *Capsicum annum cv.* NP-46A. Higher doses gave better results and chopped leaves of *C. procera* produced the greatest reduction in nematode population.

Parvathreddy *et al*., (1993) [10] applied chopped leaves of neem, lantana, *Calotropis*, castor, marigold *Parthenium*, sesamum and periwinkle each at 100g/2kg infested soil against *Meloidogyne incognita* on papaya *cv.* Coorg Honey Dew under glass house conditions and observed that caster and neem leaves gave highest shoot length and shoot weight. Siddiqi *et al*., (2004) [15] reported that aqueous extract of *Amaranthus viridis* did not significantly influence egg hatch of *Meloidogyne javanica* in vitro, the extract did cause substantial mortality of *M. javanica* juveniles at both 24 and 48 hours. Soil amendment with cropped shoot material of *A. viridis* at 5 % concentration significantly reduced galling intensity due to *M. javanica* in mung bean. Soils amended with *A. viridis* at 5% suppressed root knot nematode disease either directly through the production of nematicide compounds or indirectly by altering the soil fungal community structure, rendering it harmful to the nematodes. Rajvanshi and Bishnoi (2012) [12] carried out trial to manage cereal cyst nematode, *H. avenae* on wheat and barley. All the treatments were exhibited significantly higher grain yield and reduced number of cereal cyst nematode counts per 200 cc soil over untreated check. In barley, the grain yield of RD-2035 was maximum 48.7 q/ha followed by Carbofuran 3G at 1.0 kg ai/ha (36.1 q/ha) and neem oil + vermicompost (33.0 q/ha) as compared to susceptible in resistant variety (7.6) followed by Carbofuran (10.0), neem oil + vermicompost (14.6) as compared to farmer's practice. Meena *et al*., (2016) [8] investigated the effect of Neem (*Azadirachta indica*), jatropha (*Jathropha curcas*) and lantana (*Lantana camara*) leaves powder at 1, 2 and 4 q/ha as organic amendment for the management of maize cyst nematode, *H. zeae* on maize. Result revealed that plant products significantly reduced nematode infection over check. However, neem leaves powder at 4 q/ha was found to be the most effective in improving growth of maize and reducing the infection of *Heterodera zeae*. Khoraniya and Baheti (2020) [4] conducted a research to determine alternative methods which may be effective, economical and eco-friendly for the management of root-knot nematode, *Meloidogyne incognita* on chickpea. Experimental findings showed that the seed treatment with Periwinkle leaves powder at 10 % w/w was most effective followed by *Parthenium* leaves powder at 10 % and Water hyacinth leaves powder at 10 % w/w in improving plant growth of chickpea and to reduce reproduction of root-knot nematode, *Meloidogyne incognita*.

These findings revealed that seed and soil treatment with plant products reduced infection of nematode might be due to nemato-toxic compound *viz.*, azadirachtin, parthenin, lantanoic acid and phenolic acid (salicylic acid, vanilic acid, fereelic acid) released during decomposition of neem, parthenium, lantana and amaranthus, respectively. These findings clearly shows that application of botanicals as seed and soil treatment enhanced plant growth and crop yield in nematode infested areas. Different leaves powder express different reactions with respect to plant growth and nematode reproduction parameters. The suppression of nematodes may be due to effect of several factors. Production of volatile fatty acids, phenols, ammonia, amino acids, HCN etc. during decomposition of plant products which may cause inhibitory effect to the phytonematodes. The microbial metabolites released during decomposition may be directly toxic and hazardous to nematodes. Botanical treatments also enhance activity of number of predators and parasites which may feed and kill the plant parasitic nematodes.

Table 1: Effect of botanical leaves powder as seed and soil treatment for the management of cereal cyst nematode, *Heterodera avenae* infecting wheat

Treatments	Plant Growth Parameter*		Nematode Reproduction Parameters**			
	Shoot length (cm)	Shoot weight (g)	No. of females/ plant	No. of cysts/ 200 cc soil	No. of juveniles/ 200 cc soil	
Gajar grass 2% w/w + 1g/pot SA (T1)	51.80 (8.43)	12.60 (4.50)	25.00 (16.15)	37.75 (11.69)	525.75 (45.54)	
Gajar grass 1% w/w + 2g/pot SA (T2)	60.25 (17.79)	14.07 (40.70)	23.25 (31.53)	32.50 (23.97)	422.00 (56.29)	
Lantana 2 % w/w + 1g/pot SA (T3)	56.27 (26.12)	12.95 (29.50)	24.25 (21.23)	34.00 (20.46)	514.50 (46.71)	
Lantana 1% w/w + 2g/pot SA (T4)	62.75 (31.35)	17.32 (73.20)	21.50 (30.76)	32.00 (25.14)	341.50 (64.62)	
Amaranthus 2% w/w + 1g/pot SA (T5)	67.45 (48.88)	17.77 (77.77)	20.50 (40.00)	29.25 (31.57)	304.75 (68.43)	
Amaranthus 1% w/w + 2g/pot SA (T6)	78.12 (61.44)	19.95 (99.50)	17.25 (43.07)	24.50 (42.69)	275.50 (71.46)	
Neem leaf 2% w/w + 2g/pot SA (T7)	79.75 (66.94)	23.80 (138.00)	11.00 (46.92)	22.75 (46.78)	248.75 (74.23)	
Untreated check (T8)	47.77	10.00	28.00	42.75	965.50	
SEm+	0.61	0.39	0.81		0.84	13.00
CD at 5%	1.78	1.12	2.34		2.44	37.51

Data are the average value of four replications.

Figures in parentheses are per cent increase (*) or decrease (**) over check

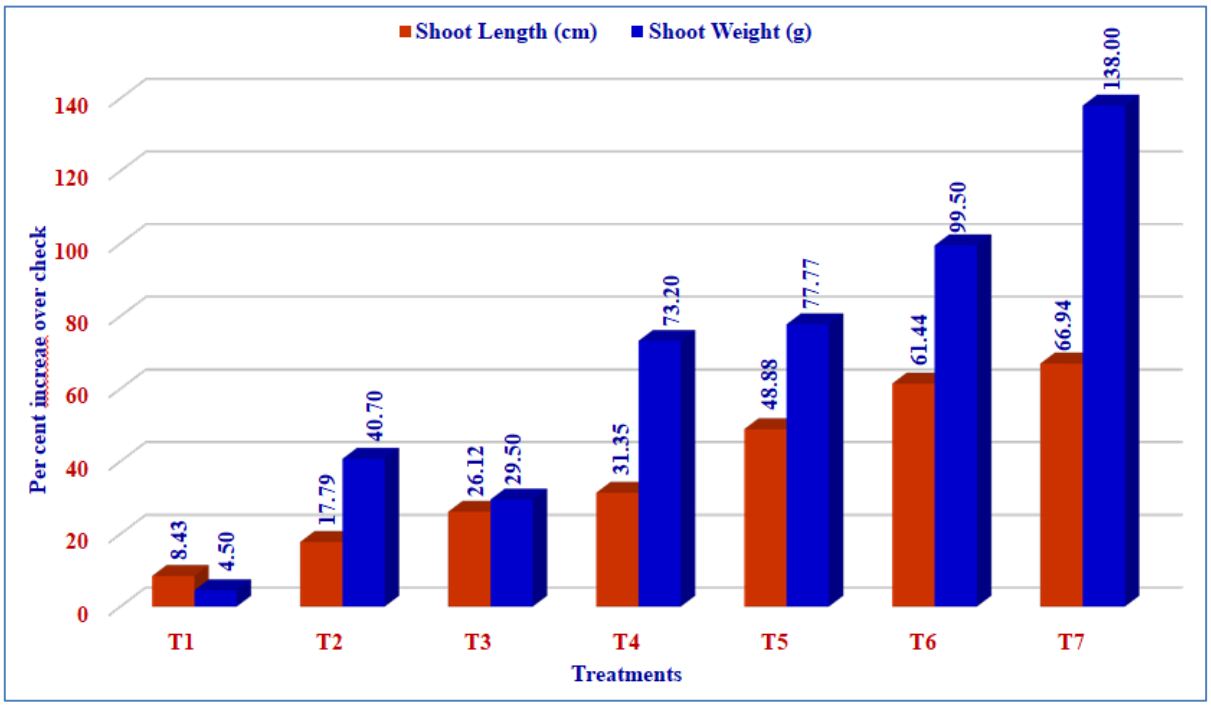

Fig 1: Effect of botanicals as seed and soil treatment on plant growth of wheat infested with *Heterodera avenae*

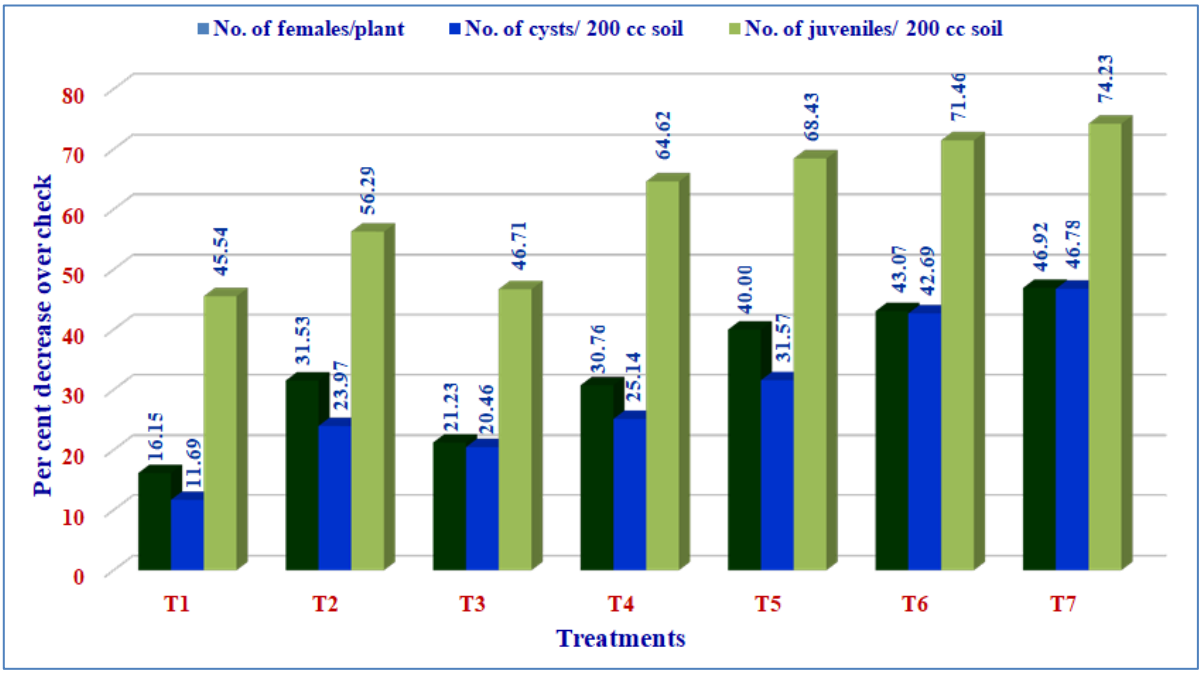

Fig 2: Effect of plant leaves powder as seed and soil treatment against cereal cyst nematode, *Heterodera avenae* on wheat

Acknowledgement
The authors are highly grateful to The Dean, Rajasthan College of Agriculture and The Director Research, MPUAT, Udaipur (Raj) for guidance and providing necessary fascilities during the course of investigation.

References

1. Akhtar M, Alam MM. Evaluation of nematicidal potential in some medicinal plants. International Nematology Network Newsletter 1989;6:8-10
2. Anonymous. Agriculture Statistics at a Glance-2018. Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi 2018.
3. Baheti BL, Dodwadia M, Rathore BS, Bhati SS. Management of maize cyst nematode, *Heterodera zeae* on sweet corn (*Zea mays* L. *saccharata*) through soil amendment. The Ecoscan 2015;7:305-309.
4. Khoraniya P, Baheti BL. Bio efficacy of botanical based seed treatment against root knot nematode, *Meloidogyne incognita* infesting chickpea (*Cicer arietinum* L.). Journal of Entomology and Zoology Studies 2020;8(3):9-12.
5. Koshy PK, Swarup G. Distribution of *Heterodera avenae*, *H. zeae*, *H. cajani* and *Anguina tritici* in India. Indian Journal of Nematology 1971;1:106-111.
6. Kuhn J. Uber das vorkommen Von Rubennematoden a den wurzeln der Halmfruchte, Londwn. Jbr 1874;3:47-50.
7. Mathur BN. Studies on the cereal root eelworm (*H. avenae* Woll.) with special reference to ‘Molya’ disease of wheat and barley in Rajasthan. Ph.D. Thesis, University of Rajasthan, Jaipur 1969,233p.

8. Meena KK, Baheti BL, Rathore BS, Chandrawat BS. Organic amendment: An important tool for the management of maize cyst nematode, *Heterodera zeae* on maize *(Zea mays* L.). Current Nematology 2016;26(1,2):23-27
9. Mehta SK, Baheti BL, Rathore BS, Nama CP. Botanicals-An effective tool for the management of maize cyst nematode, *Heterodera zeae* on maize (*Zea mays* L.). Journal of Biopesticides 2015;8(2):62-67.
10. Parvathareddy P, Khan RM, Rao MS. Management of root knot nematode infesting papaya by incorporating some plant leaves, Botanical pesticides in integrated pest management, Proceedings of National Symposium held at Central Tobacco Research Institute, Rajahmundry, India 1993,421-423
11. Prasad N, Mathur RL, Sehgal SP. 'Molya' disease of wheat and barley in Rajasthan. Current Science 1959;28(11):453.
12. Rajvanshi I, Bishnoi SP. Influence of Seed Treatment of Neem Based Formulations and Chemical on Populations of Cereal Cyst Nematode, *Heterodera avenae* Infecting Wheat and Barley. Indian Journal of Nematology 2012;42:103-106.
13. Ram, Budh, Baheti BL. Management of reniform nematode, *Rotylenchulus reniformis* on cowpea through seed and soil treatment with plant products. Indian Journal of Nematolology 2004;34:193-195.
14. Sharma SK, Sharma GL, Baheti BL. Management of root-knot nematode, *Meloidogyne incognita* on tomato through soil amendment with various composts. Indian Journal of Nematolology 1996;26:263-265.
15. Siddiqui IA, Hussain I, Shaukat SS, Zarina A. Nematicide, antifungal and allelopathic activities of *Amaranthus viridis* L. International Journal of Biology and Biotechnology 2004;1:603-611.
16. Swarup G, Singh K. 'Molya' disease of wheat and barley in Rajasthan. Indian Phytopathology 1961;14:127-133.
17. Vasudeva RS. Report of the Division of Mycology and Plant Pathology. Scientific Report of the Agricultural Research Institute, New Delhi 1958.
18. Van Berkum JA, Seshadri AR. Some important nematode problems in India. International Symposium of Nematology, Italy 1970,136-137p.