



Research Article

LIFE CYCLE OF MAIZE CYST NEMATODE, *HETERODERA ZEA* ON SWEET CORN (*Zea mays* L. *saccharata*)

BAHETI B.L., DODWADIYA MUKESH, BHATI S.S.* , KHANDELWAL S.K.¹ AND RATHORE B.S.

Department of Nematology & MBBT¹, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur-313001, India

*Corresponding Author: Email-shakti.singh3880@gmail.com

Received: June 14, 2016; Revised: July 02, 2016; Accepted: July 03, 2016; Published: October 18, 2016

Abstract- An experimental trial was carried out to know the time required to complete the life cycle of maize cyst nematode, *Heterodera zea* on sweet corn (var.- Madhuri). Life cycle studies revealed that second stage larvae of maize cyst nematode, *H. zea* are the infective stage and penetrated sweet corn roots at 48 hours of inoculation. After penetration, the third stage larvae were observed on the 6th day of inoculation. Fourth stage larvae and a dult females were observed at 13th and 19th day after inoculation, respectively. The mature cyst of *H. zea* was observed on the 25th day after inoculation. Thus, the life cycle of maize cyst nematode, *H. zea* on sweet corn took place in 25 days after inoculation of second stage larvae.

Keywords- Life cycle, *Heterodera zea*, Sweet corn

Citation: Baheti B.L., et al., (2016) Life Cycle of Maize Cyst Nematode, *Heterodera zea* on Sweet Corn (*Zea mays* L. *saccharata*). International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 48, pp.-2017-2019.

Copyright: Copyright©2016 Baheti B.L., et al., This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Academic Editor / Reviewer: Suman Kanwar, B.S. Chandrawat, Ramanjali T, Raj Chandramani

Introduction

Maize (*Zea mays* L.) is, globally a top ranking cereal in productivity and has great significance as a food, animal and poultry feed and as a source of industrial products. In India, it ranks third place after rice and wheat with an area of 9.43 million hectares, production of 24.35 million tonnes and productivity of 2583 kg/ha [1].

Maize being multi-utility crop, unique among the cereals with more than 3500 different uses. Recently, after introduction of specialty corn as sweet corn, quality protein maize, popcorn, baby corn etc. are suitable for specific usages. Among them, sweet corn usage is increasing very rapidly in cities and their periphery areas throughout the country. It is very delicious and nutritious crop and used as fresh or in boiling foam. Sweet corn is one of the most popular vegetable in the USA, Europe and other advanced countries of the world and its consumption is increasing extensively in Eastern Asia [22].

The ears picked at green young stage are used for canning and table purpose. In India, it is gaining importance, particularly in star hotels of urban areas for the preparations of soups, jams, cream pastries and other delicious products. The crop is harvested in about 60 to 75 days after sowing. It has tremendously attracted the attention of central/state governments as well as large and marginal farmers because of their huge potential, multidimensional utility (vegetable, food processing and tourist industries, table purpose in various ceremonies etc.). It gives good economic returns to the growers in short duration. A Green stalk of sweet corn is very delicious fodder and enhances the quality and quantity of milk animals.

Maize production in India and abroad is greatly affected by several biotic factors i.e. fungi, bacteria, insect pests and nematodes. Among them, plant parasitic nematodes are responsible to cause 10.2% losses on maize [17]. Plant parasitic nematodes viz., cyst nematodes (*Heterodera* spp.), lesion nematodes (*Pratylenchus* spp.), root knot nematodes (*Meloidogyne* spp.), stunt nematode (*Tylenchorhynchus* spp.) and spiral nematode (*Helicotylenchus* spp.) have been

found to be associated with maize [9, 13-15, 18].

Nematodes also interact with other disease causing agents (pathogens and soil insects) and adversely affect the quantity and quality of maize production. Among nematodes, maize cyst nematode, (*Heterodera zea*) is considered to be the most important nematode pest of maize in India [10]. It was first reported by Koshy *et al.* (1970) [6] from the Chhapli village of Udaipur district of Rajasthan. It is widely distributed in maize growing areas of Rajasthan, Delhi, Punjab, Haryana, Himachal, U.P., Bihar, M.P., Gujrat, Tamilnadu, Karnataka, A.P. and Maharashtra etc. [5,7,16]. Srivastava and Chawla (2005) [21] reported yield losses of maize to the extent of 17-29 % by the maize cyst nematode, *H. zea* in India at varied inoculum levels and soil conditions.

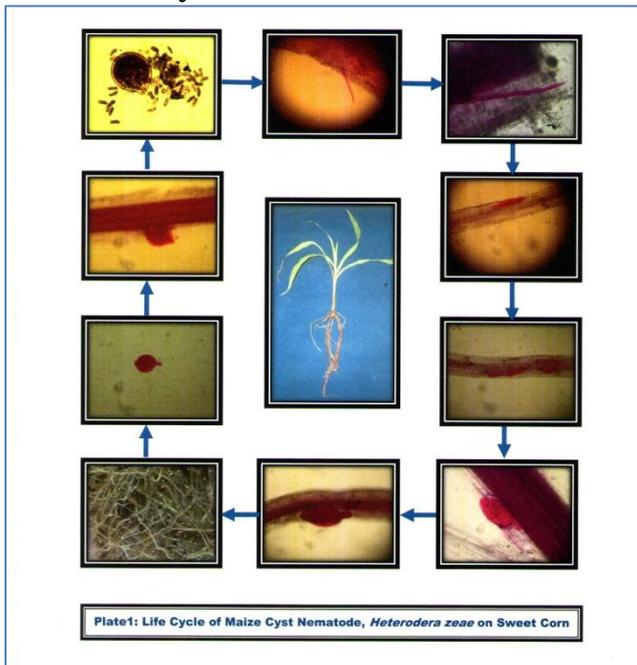
Materials and Methods

One hundred earthen pots were filled with sterilized sandy loam soil and two seeds of sweet corn were sown in each pot. After five days of germination, one hundred freshly hatched second stage larvae of *Heterodera zea* were carefully inoculated in rhizosphere of plant. After inoculation, three pots were deported initially at 6 hours interval till penetration observed.

Thereafter, pots were deported daily till mature cysts were observed. The roots were carefully washed in running tap water to remove adhering soil particles and stained with 0.1% acid fuchsin lacto-phenol solution. To remove excess stain, the stained roots were washed in running tap water and kept in clear lacto-phenol for at least twenty four hours before observation. The roots were examined under stereoscopic binocular microscope to observe different stages of *Heterodera zea*. The results of present investigations have been presented in table-1 and illustrated through plate-1.

Results and Discussion

Observations on life cycle of maize cyst nematode, *Heterodera zae* on sweet corn (var.- Madhuri) showed that the first evidence of second stage larval penetration was observed in roots at 48 hours of inoculation. The penetration was observed in zone of elongation and larvae were found to penetrate both in the tap as well as in lateral roots. The larvae were fully embedded in root just after penetration. The results of the present investigation are in accordance with the findings of Kaul and Sethi (1982) [4] who observed that the J₂ of *H. zae* prefer to penetrate meristematic tissue and the zone of elongation on maize and penetration occurs in 48-72 hrs. However, Srivastava and Sethi (1985) [19]; Mishra *et al.* (1985) [11] and Bajaj *et al.* (1987) [2] reported different time interval for penetration of *H. zae* on maize. The differences in time of larval penetration might be due to difference in variety, degree of attractiveness to the larvae by the host roots, temperature, soil type and other factors governing penetration during the course of the investigation.



The third stage larvae were observed on the 6th day after inoculation. At this stage, the development of the gonad initiated, but sex differentiation was not detectable. The head region of larvae has three annules, tapering anteriorly, stylet prominent, median bulb large with a conspicuous valve. In the later stage, the larvae developing into females showed the bifurcated development of the genital cells. The evidence of 4th stage larvae was observed on the 13th day after inoculation. The female larvae were observed to have thin cuticle and swollen posteriorly whereas males remain in vermiform. Stylet of female larvae was embedded inside the stellar region of roots and the rest of the body remains outside the maize roots.

Adult females of *H. zae* were observed on the 19th day after inoculation. An adult female was lemon shaped with reflexes and coiled ovaries. It has well developed neck and vulva with thin wall cuticle. The adult female started turning yellow/brown and change into a mature cyst after 25th days of inoculation. Several times the eggs retained in cysts are easily visible from outside due to thin cuticle of the cyst. The vulval cone was generally prominent and the sub crystalline layer was observed on new cyst. Then, vulval cone was prepared and critically examined under high power of the microscope, ambifenestrations were seen and identified as cyst of *Heterodera zae*. Thus, under the experimental conditions, the life cycle of *Heterodera zae* from second stage larvae to the formation of mature cyst was completed in 25 days of inoculation on sweet corn.

The results of the present investigation are in accordance with the findings of Parihar and Yadav (1992) [12] who reported that *Heterodera zae* complete its life cycle in 25 days at a temperature range of 28-36 °C. Similarly, Srivastava and Kaushal (1991) [20] reported that *H. sorghi* was able to complete its life cycle from

the J₂ to the next generation J₂ in 24 days on maize cv. Deccan-103. However, different workers reported different time to complete the life cycle of *H. zae* on maize. Verma and Yadav (1975) [23] reported that the life cycle of the cyst nematode, *H. zae* on maize was completed in 20 days. Lauritis *et al.* (1983) [8] reported that *Heterodera zae* took 22 days from the date of inoculation of second stage larvae to the first appearance of newly hatched second stage juvenile. Hutzell and Krusberg (1990) [3] reported that the life cycle of *H. zae* from the second stage juvenile (J₂) to (J₂) was completed in 15-18 days at 33° C, while at 36 °C, 19-18 days were required on maize cv. Pioneer 3184.

Table-1 Studies on life cycle of maize cyst nematode, *Heterodera zae* on sweet corn (*Zea mays L. saccharata*)

S. No.	Developmental Stage	Time after inoculation of second stage larvae
1.	Penetration (2 nd stage larvae)	48 hour
2.	3 rd stage larvae	6 th day
3.	4 th stage larvae	13 th day
4.	Adult female	19 th day
5.	Mature cyst	25 th day

These differences in time taken by the nematode to complete its life cycle may be due to differences in crop variety, soil type, physical conditions such as temperature, moisture, relative humidity etc. during the course of experimentation.

Acknowledgement:

The authors of present research article are highly thankful to the Head, Department of Nematology, Rajasthan College of Agriculture, MPUAT, Udaipur (Raj) for providing necessary facilities, critical suggestions and to reviewed the article.

Conflict of Interest: None declared

References

[1] Anonymous (2015) Department of Agriculture and Cooperation, New Delhi, Government of India.
 [2] Bajaj H.K., Gupta D.C. and Dahiya R.S. (1987) *Nematologica*, 32 (2), 209-215.
 [3] Hutzell P.A. and Krusberg L.R. (1990) *Journal of Nematology*, 22, 414-417
 [4] Kaul R.K. and Sethi C.L. (1982) *Indian Journal of Nematology*, 12, 79-85.
 [5] Kaushal K.K., Shrivastava A.N., Pankaj Chawla G. and Singh K. (2007) *Indian Journal of Nematology*, 37, 1-7.
 [6] Koshy P.K., Swarup G. and Sethi C.L. (1970) *Nematologica*, 16, 511-16.
 [7] Koshy P.K. and Swarup G. (1971) *Indian Journal of Nematology*, 1, 106-111.
 [8] Lauritis J.A., Rebois R.v. and Greney L.S. (1983) *Journal of Nematology*, 15, 115-119
 [9] Mehta S.K., Baheti B.L., Nama C.P. and Rathore B.S. (2015) *Current Nematology*, 26(1,2), 45-49, 2015
 [10] Mehta, S.K., Baheti, B.L., Nama, C.P. and Rathore, B.S. (2016) *Progressive Research*, 11 (Special-I), 407-410.
 [11] Mishra S.N., Edward J.C. and Gupta P. (1985) *Indian Journal of Nematology*, 15, 111-112.
 [12] Parihar A. and Yadav B.S. (1992) *Pakistan Journal of Nematology*, 10, 99-101.
 [13] Patel N.B., Patel R.G., Patel A.D., Patel H.V., Patel B.A. and Patel D.J. (2000) *Indian Journal of Nematology*, 30, 95-96.
 [14] Payak M.M. and Sharma R.C. (1980) An investigation and bibliography for maize diseases in India. *Division of Mycology and Plant Pathology, IARI*. New Delhi.
 [15] Rai B.B. (1969) *Allahabad Farmers*, 43, 315-319.
 [16] Rathore B.S., Singh H. and Baheti B.L. (2007) *Journal of Mycology and Plant Pathology*, 37, 122-23.
 [17] Sasser J.N. and Freckman D.W. (1987) *World Perspective on Nematology: The role of the Society*. In *Vistas on Nematology: a Commemoration of*.

- eds the Twenty fifth Anniversary of the Society of Nematologists. J.A. Veech and D.W. Dickson. *Society of Nematologists*, Inc. Hyattsville, M.D. pp. 7-14
- [18] Singh H. and Rathore B.S. (2001) Estimation of yield losses in maize due to maize cyst nematode, *Heterodera zaeae*. In: National Congress on *Centenary of Nematology in India- Appraisal and Future Plans* held at IARI New Delhi from 5-7 Dec. 2001 pp. 157.
- [19] Srivastava A.N. and Sethi C.L. (1985) *Indian Journal Nematology*, 15, 18-20
- [20] Srivastava A.N. and Kaushal K.K. (1991) *Indian Journal of Nematology*, 21, 163-64.
- [21] Srivastava A.N. and Chawla G. (2005) Maize cyst nematode, *Heterodera zaeae*: A key nematode pest of maize and its management. IARI, New Delhi- 18 pp.
- [22] Tracy W.F. (1994) Sweetcorn In: *Speciality corns* (Eds. Arnel R. Hallauer) CRC Press, London pp.148-187.
- [23] Verma A.C. and Yadav B.S. (1975) *Indian Journal of Mycology and Plant Pathology*, 5, 19.