

Original Research Article

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Cultural Management of Plant Parasitic Nematodes and Yield of Greengram, Blackgram and Jute under Seed Production Programme

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ABSTRACT

Keywords

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Selection of proper cropping sequence, summer ploughing, application compost in soil and soil incorporation of greenmanuring crop is found to be effective in reducing the population of plant parasitic nematodes in soil. Among the three different cropping sequences, toria-dhaincha-jute/greengram/blackgram recorded greatest reduction of final population of plant parasitic nematodes in soil followed by the cropping sequences toria- fallow- jute/greengram/blackgram. Maximum seed yield of greengram, blackgram and jute was also recorded in the sequence of toria-dhaincha-jute/greengram/blackgram.

Introduction

In Assam greengram and blackgram is most popularly cultivated pulse crop. Similarly jute is considered as most important fibre crop. These crops are attacked by a number of pests and diseases which causes considerable loss in production. Among them plant parasitic nematodes are presently considered to be one of the important production constraints of crops like greengram, blackgram and jute. Although considerable number of plant

parasitic nematode has been recorded to be associated with these crops, the root-knot nematode, *Meloidogyne incognita* is considered to be more destructive one which causes considerable yield losses of greengram, blackgram and jute (Saikia and Phukan, 1986; Kalita, 1988). The tiny plant parasitic nematodes feed on roots, underground plant parts and also aerial plant parts in few cases. Besides this, most of them act as aggravator, vectors and predisposing agents to fungi and bacteria. Role of plant parasitic nematodes in

agriculture has remained been underestimated due to their soil borne nature, microscopic size and hidden mode of life and exhibition of non typical insidious damage symptoms on plants. Symptoms caused by phytoparasitic nematodes are non-specific in nature and often resemble with the symptoms caused by mineral deficiency, effect of salinity and alkalinity, water stress and mineral toxicity. Thus symptoms, like general yellowing, stunting, wilting during the hottest part of the day, chlorosis, premature shedding of leaves and poor appearance of plants resulting in low yields are very common.

Chemical pesticides can effectively be used for the management of nematode pests of crops. But indiscriminate use of pesticides has caused immense damage to the entire ecosystems. A variety of undesirable environmental effects including excessive mortality and reduced reproductive potential of beneficial organisms, change in the abundance of species and diversity of ecosystem, reduction in natural resources and development of pesticide resistance in target and non-target species have been reported by the application of pesticides.

With the growing awareness of limitation of pesticides, there is need to adopt alternative approaches in the management of nematode pests of crops. The selection of proper cropping sequence, soil solarization, sanitation, application of soil with compost, residue of crops, soil incorporation of greenmanuring crop are recognized as efficient methods of changing soil environment adversely influencing the activities of plant parasitic nematodes and at the same time also helps in improving soil fertility. Some work has been done earlier by various workers on the use of crop rotation and different cropping sequences using host and non-host crops, soil solarization, organic soil amendments, soil incorporation of greenmanuring crop for the management of

plant parasitic nematodes on various crops (Jain and Bhatti, 1985; Blair, 1992; Abdul Hamid Wani, 2005; Thakur, 2007)

Hence in the present study was undertaken to see the effect of different cropping sequences in combination with other cultural practices like fallowing, deep summer ploughing, soil incorporation of green manuring crop, soil incorporation of compost and crop residue, sanitation etc. on population of plant parasitic nematodes and yield of greengram, blackgram and jute under seed production programme.

Materials and Methods

Experimental site

The present investigation was undertaken in seed production trial conducted at BN College of Agriculture farm, AAU Biswanath Chariali during 2015-2018 in three consecutive year of different site of the farm. Before preparation of field different soil characteristic were recorded and presented in (Table 1). In the field moderate to high population of plant parasitic nematodes viz. *Meloidogyne* sp., *Helicotylenchus* sp., *Hoplolaimus* sp., *Tylenchorhynchus* sp., *Criconematids* and *Xiphinema* sp. was recorded.

Sources of seeds

Greengram seeds (var SG1, SGC-16), blackgram seeds (var PU31) and jute seeds (var Tarun) were obtained from Regional Agricultural Research Station (RARS) of AAU, Shillongani, Nagaon, Assam.

Pre-sowing treatment of seeds

Seeds were washed with clean tap water and were surface sterilized with 0.1 percent mercuric chloride solution for 1-2 minutes and then washed thoroughly with sterile water. The wet seeds were dried in the air.

Germination test

Seeds were tested for germination in the laboratory and 100 per cent germination was obtained.

Sowing of seeds and interculture operation

Seeds of greengram and blackgram were sown in rows maintaining a spacing of 30cm x 10cm from row to row and plant to plant. Jute seeds were also sown in rows maintain a spacing of 30cm x15cm from row to row and plant to plant. All other recommended package of practices followed accordingly in each crop. Proper care was taken to protect the seedling through the crop growing period and the plots were free from weeds.

Collection of soil samples for extraction of nematodes

Soil samples were collected in two times. One from fallow land before starting of the trial (before sowing of first crop)for recording initial nematode population in the field and other at the time of harvesting of the crop from root zone to record final nematode population in soil. Soil samples were collected randomly from the site of the trial. Ten sub samples were collected from each crop and mixed thoroughly to make a composite sample.

Extraction of nematode from soil

Nematodes from soil were extracted by following the Cobb's sieving, decanting and filter technique (Christie and Perry, 1951) using a series of sieves (20, 60, 150, 250 and 350 mesh). Each soil sample was thoroughly mixed and 200 ml of soil was drawn from the homogenous mixture for processing and was put in a plastic bucket (Pan-1) containing about one liter of water.

The lumps were broken with the help of fingers, stirred the soil suspension and allowed the soil particles to settle at the bottom of the bucket for about 10 seconds. The suspension was then poured into Pan-2 through a 20 mesh sieve to remove stone and other coarse materials. Soil suspension was stirred and allowed to settle for about 20 seconds and poured into Pan-1 through 60 mesh sieve, leaving the heavy particles in the bucket. The suspension was then passed through 150 mesh sieve. The residue from the 150 mesh sieve was collected in a beaker.

Similarly the suspension was allowed to pass through 250 and 350 mesh sieve and the residues left over on the sieves were collected in separate beakers. The residues from 150, 250 and 350 mesh sieves were mixed and cleaned under running tap water using 350 mesh sieve. It was then poured gently over a double layer of tissue paper stretched over an aluminium wire gauge and kept on a petridish containing filter water. The water on the petridish should touch the bottom of aluminium wire gauge. The nematode suspension was collected after 24 hours and later examined under a stereoscopic binocular microscope and the nematode population was recorded.

Results and Discussion

Analysis of soil samples from the experiment site revealed the presence of various ecto and endoparasitic nematodes viz., *Meloidogyne sp*, *Hoplolaimus sp.*, *Helicotylenchus sp.*, *Tylenchorhynchus sp.*, *Criconematid* and *Xiphinema sp.*

In the present investigation it shows that various cropping sequences along with other intervention brought about reduction in final population of plant parasitic nematodes in soil.

Table.1 Soil parameters in different site of seed production trial of the farm

Site of farm	N (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (Kg/ha)	Organic matter (%)	P ^H
Site 1	294.78	41.69	210.16	1.06	4.39
Site 2	304.19	41.57	229.92	1.10	4.59
Site 3	310.64	42.46	237.04	1.13	4.79

Table.2 Population change of phytoparasitic nematode in soil and seed yield of jute under different cropping sequence

Year	Site of the farm	Crop sequence	Other interventions taken	Initial nematode population in soil before sowing of first crop (200c.c)	Final nematode population in soil at the time of harvesting of jute (200 c.c soil)	% decrease over INP	Seed yield (q/ha)
2015-16	Site1	Toria-Dhaincha-Jute	Deep summer ploughing, soil incorporation of dhaincha as greenmanure, application of compost and crop residue before sowing of jute	270	199	26.30	3.0
2016-17	Site2	Toria-Fallow-Jute	Application of compost and crop residue before sowing of jute	295	242	17.97	1.5
2017-18	Site3	Fallow-Dhaincha-Jute	Soil incorporation of dhaincha	316	265	16.14	1.0

Table.3 Population change of phytoparasitic nematode in soil and seed yield of greengram under different cropping sequence

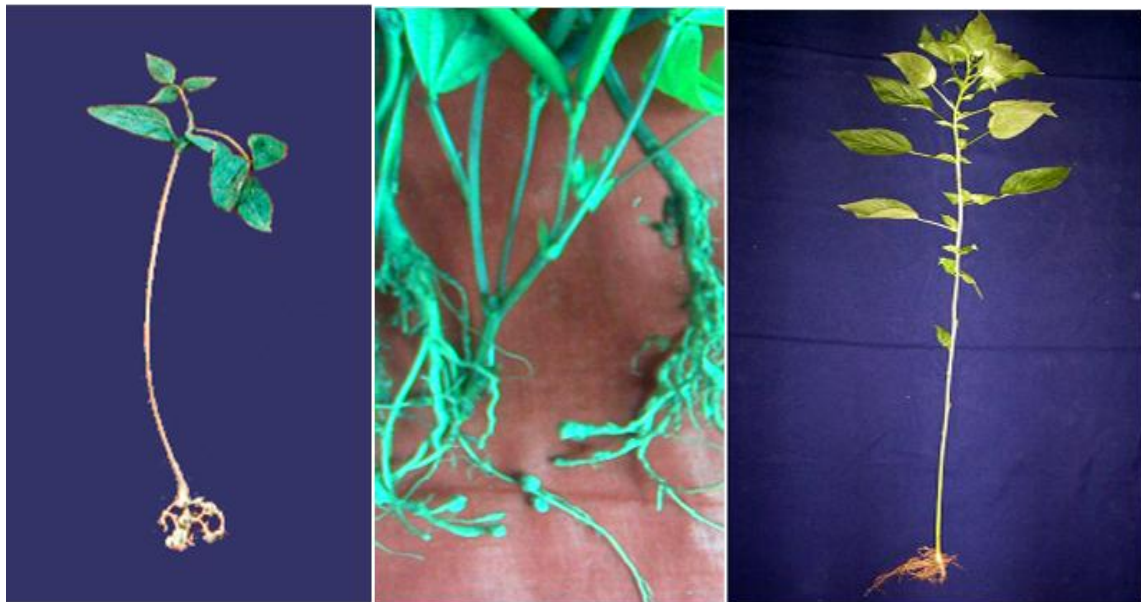
Year	Site of the farm	Crop sequence	Other interventions taken	Initial nematode population in soil before sowing of first crop (200c.c)	Final nematode population in soil at the time of harvesting of greengram (200c.c soil)	% decrease over INP	Seed yield (q/ha)
2015-16	Site1	Toria-Dhaincha-Greengram	Deep summer ploughing, soil incorporation of dhaincha as greenmanure, application of compost and crop residue before sowing of greengram	270	195	27.77	4.4
2016-17	Site2	Toria-Fallow-Greengram	Application of compost and crop residue before sowing of greengram	295	240	18.64	3.0
2017-18	Site3	Fallow-Dhaincha-Greengram	Soil incorporation of dhaincha as greenmanure	316	265	16.14	1.05

Table.4 Population change of phytoparasitic nematode in soil and seed yield of blackgram under different cropping sequence

Year	Site of farm	Crop sequence	Other interventions taken	Initial nematode population in soil before sowing of first crop (200c.c)	Final nematode population in soil at the time of harvesting of blackgram (200c.c soil)	% decrease over INP	Seed yield (q/ha)
2015-16	Site1	Toria-Dhaincha-Blackgram	Deep summer ploughing, soil incorporation of dhaincha as greenmanure, application of compost and crop residue before sowing of blackgram	270	160	40.74	8.7
2016-17	Site2	Toria-Fallow-Blackgram	Application of compost and crop residue before sowing of blackgram	295	218	26.10	2.0
2017-18	Site3	Fallow-Dhaincha-Blackgram	Soil incorporation of dhaincha as greenmanure	316	245	22.47	1.5



Fig.1 Microscopic view of different plant parasitic nematodes recorded in the field



A

B

C

Fig.2 Symptoms of production root galls on root system of (A) Greengram (B) Blackgram and (C) Jute plants by *Meloidogyne* sp. in seed production plots



Fig.3A Crop sequence Toria—Dhaincha--Greengram



Fig.3B Crop sequence Toria---Dhaincha—Blackgram

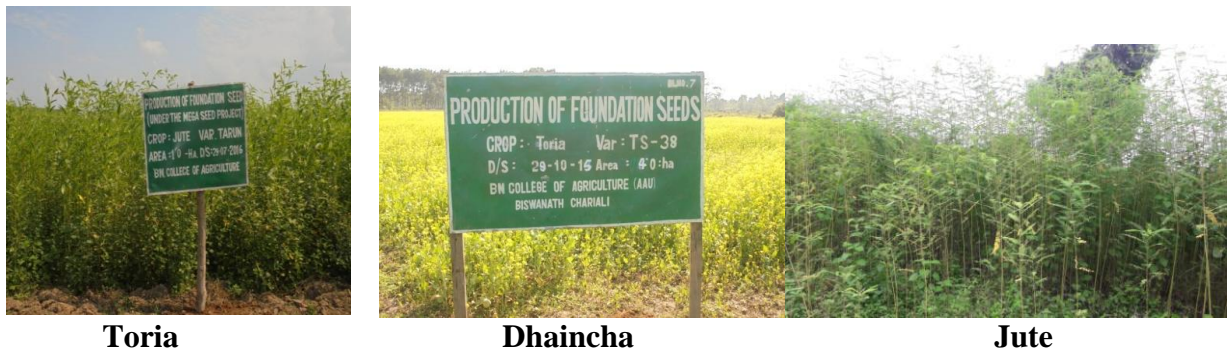


Fig.3C Crop sequence Toria—Dhaincha—Jute



Toria

Fallow



Greengram

Fig.4A Crop sequence Toria—Fallow--Greengram



Toria

Fallow



Blackgram

Fig.4B Crop sequence Toria—Fallow--Blackgram



Toria

Fallow



Jute

Fig.4C Crop sequence Toria—Fallow--Jute

Fallow



Fallow

Dhaincha

Greengram

Fig.5A Crop sequence Fallow--Dhaincha – Greengram

Fallow



Fallow

Dhaincha

Blackgram

Fig.5B Crop sequence Fallow--Dhaincha – Blackgram

Fallow



Fallow

Dhaincha

Jute

Fig.5C Crop sequence Fallow--Dhaincha – Jute

Among different cropping sequences, toria-dhaincha-jute/greengram/blackgram recorded greatest reduction of final nematode population in soil followed in order of efficacy by the cropping sequences toria-fallow- jute/ greengram/blackgram (Table 2, 3 and 4). In the sequence toria-dhaincha-jute/greengram/ blackgram also recorded highest seed yield of all the crops. The highest reduction of nematode population and increase seed yield of the crops in this sequence may be due to incorporation of other intervention like deep summer ploughing, soil incorporation of dhaincha, application of compost and crop residue etc.

Mathur *et al.*, (1987) observed that 1-5 deep summer ploughings in May-June resulted in reduction in population of cereal cyst nematodes and increased yield of wheat crop. Depth of ploughing played important role in reducing the population of plant parasitic nematodes as the nematodes are exposed to solar heat (Jain and Bhatti, 1985; Mathur *et al.*, 1991). Different soil amendment methods like application of oil cakes, organic manures and mulching of green leaves, have reported to reduce the disease and improve plant growth and yield in various crops (Sikdhar *et al.*, 1986; Govindaiah *et al.*, 1989; Siddiqui *et al.*, 1992; Mohanty *et al.*, 1992)

The selection of proper cropping sequence is an effective method for reducing nematode population and limiting the crop damage (Nusbaum and Ferris, 1973). The beneficial effects of different cropping sequences might be due to the fact that nematode population is maintained below the threshold level either by growing non-host crop in the cropping sequence (Khan *et al.*, 1975, 1984; Alam *et al.*, 1977, 1981; Rodruez-Kabana, 1990 and Rodruez-Kabana and Canuila, 1992).

The nematicidal impact of various crops like marigold, sunhemp, sesamum, mustard and

Zinnia as intercrops for the management of root-knot nematode disease have been reported (Haque and Gaur, 1988; Jain *et al.*, 1990).

Similar to the findings in the present investigation, the efficacy of growing mustard in cropping sequence on nematode population has been reported earlier by Harinath Naidu *et al.*, (2000) and Abdul Hamid Wani (2005). The reduction in nematode population due to incorporation of toria has been attributed to the toxic root exudates allyl isothiocyanate.

The present investigation clearly indicate that incorporation of non-host crop in cropping sequences along with deep ploughing, soil incorporation of green manuring crop and application of compost and crop residue brought about reduction in final nematode population in soil and improvement in plant growth and yield. But care must be taken in selecting appropriate crops, which should be poor hosts or non-hosts for the prevailing nematode species and also economically important.

Seed producers of different field crops are advised to follow summer ploughing, crop rotation, roguing, monitoring of seed crop to ensure purity, change the field each year for the crop, try to increase carbon content in soil by addition of biomass, green manuring, residue incorporation, encourage the buildup of resident nematode biocontrol agents population in soil.

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