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Evaluation of pulses for resistance against root-knot nematode, *Meloidogyne incognita*

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Abstract
Field studies were carried out to evaluate the reactions of pigeonpea, mungbean and chickpea against root-knot nematode (*Meloidogyne incognita*) during *Kharif* and *Rabi*, 2018- 2020. A total of 28 genotypes of pigeonpea, 20 genotypes of mungbean and 29 genotypes of chickpea were screened in sick plot area of Nematology. The initial nematode population was recorded above pathogenic level in both the seasons. The observations on number of galls/plant and number of eggmasses/plant were recorded after 45 days of sowing. The different genotypes were categorized from highly resistant to susceptible based on number of galls and gall index. Out of 28 genotypes of pigeonpea, four genotypes showed resistant reaction and 15 were moderately resistant. In case of chickpea, out of 29 genotypes; three genotypes showed resistant reaction and seven were found moderately resistant while out of 20 genotypes of mungbean, four genotypes showed moderately resistant reaction against RKN. The remaining genotypes were either categorized as susceptible or highly susceptible.

Keywords: Root-knot nematode, mungbean, chickpea, pigeonpea, resistance

Introduction
Pulses a primary source of protein and essential amino acids, can be profitable crops for farmers due to their relatively low production costs and the steady demand for these crops in the Indian market. Pulses help in crop rotation and diversification, which can improve soil fertility and reduce the risk of diseases and pests in the field. They also have the ability to fix nitrogen, benefiting subsequent crops. The declaration of 2016 as the "International Year of Pulses" by the UN Food and Agricultural Organization highlights the global significance of pulses as a food source and their contribution to sustainable agriculture. In India, different kinds of pulses such as black gram, green gram, chickpeas, kidney beans, lima beans, and black-eyed and peas are grown. Pulses are reported to have infestation of many insects pest pathogen including plant parasitic nematodes (PPNs) which cause significant damage may directly affect the physiological functioning of the plants to the extent of producing a lower yield. Nematodes are a diverse group of animals that can have both beneficial and harmful effects. Some nematodes contribute to organic matter recycling (Ferris *et al*., 2004) [6], while others, like root-knot nematodes (Jones *et al*., 2013) [8], are major pests for many crops. *Meloidogyne* sp. generally cause characteristic galls on pulses such as chickpea, pea, cowpea, green gram etc. (Khan & Salam, 1996) [9]. Worldwide, it's estimated that these losses amount to 12.3% of major crops (Walia & Bajaj, 2014) [15], with even higher losses in some regions like India where average loss caused by root-knot nematode on pulses may be 14.6% and could go as high as 50-80% in some crops (Bhatti, 1992) [2]. Yield losses caused by root-knot nematodes in different pulse crops may cause 13% in pigeon pea (Sasser & Freckman, 1987) [13]. Resistance in plants is the ability to suppress the development or reproduction of nematodes (Sasser, 1954; Hussain *et al*., 2014) [12, 7] while a susceptible plant allows nematode to reproduce freely in plants (Cook and Evans, 1987) [4]. Plant parasitic nematodes can be managed through various agronomic practices, such as crop rotation with non-host crops, deep summer plowing, bio-control agents, and organic amendments. However, resistance remains the most effective method. The screening protocol used to identify root knot nematode resistant breeding lines should be capable of readily and reliably evaluating thousands of genotypes encountered in a breeding programmed (Boerma & Hussay, 1992) [3]. So, this field study was planned for the screening of promising pulses germplasm pigeonpea, chickpea and mungbean against root-knot nematode.

Methodology

This experiment was conducted during *Kharif* and *Rabi* season 2018-2020 for the screening of pulses *i.e.*, pigeonpea, chickpea and mungbean germplasms in the sick plot area of Department of Nematology to assess the source of resistance against root-knot nematode (*M. incognita*). 28 genotypes of pigeonpea, 20 genotypes of mungbean and 29 genotypes of chickpea during *Kharif* and *Rabi* season 2018-2020 received from Pulses Section, Deptt. of Genetics and Plant Breeding, CCSHAU, Hisar, were screened. Seeds of each crop were sown in micro plots having initial nematode population above economic threshold level (>1J_2/g soil) in each respective season. 45 days after the germination, plants were uprooted carefully, roots were washed gently with tap water and the number of galls were counted. Based on number of number of galls/plant and eggmasses/plant, plants were evaluated as highly resistant, resistant, moderately resistant, susceptible and highly susceptible (Bhatti and Jain, 1994) [1].

Table 1: Gall index (Bhatti and Jain, 1994) [1]

Gall index	Disease incidence (No. of galls/plant)	Disease reaction
1	0.0	Highly Resistant
2	0.1-10.0	Resistant
3	10.1-30.0	Moderately Resistant
4	30.1-100.0	Susceptible
5	>100	Highly Susceptible

Results and Discussion

Among 29 genotypes of chickpea which were screened for their reaction against *Meloidogyne incognita*, three genotypes *viz*., H-15-04, H-15-23 and H-15-25 were found resistant (<10 number of galls/plant) while seven genotypes, H-08-18, H13-03, H-12-22, H-12-26, H-12-63, H-14-21 and H-15-27 showed moderately resistant reaction against root knot nematode (Table 3). Rest of the genotypes were found susceptible or highly susceptible and maximum number of eggmasses were recorded on H-14-11 genotype. Out of 28 genotypes of pigeonpea screened for their reaction to *Meloidogyne incognita*, AH15-07, AH17-27, AH17-28, and AH15-01 were found resistant having less than ten number of galls per plant while AH14-01, AH16-21, AH15-20, AH16-07, AH16-44, AH17-17, AH16-02, AH17-01, AH16-36, AH16-40, AH16-49, AH17-03, AH16-38, VLA-1 and PADT-16 showed moderately resistant reaction having 10.1-30.0 number of galls per plant (Table 2). Rest of genotypes were found susceptible or highly susceptible having >30 number of galls per plant and maximum number of eggmasses were recorded on AH-16-50 genotype. In case of mungbean, 20 genotypes were tested and no entry was reported to be resistant while four entries (MH-1762, MH-1767, MH 2-15 and MH-125) showed moderately resistant reaction (>10 number of galls/plant). Rest of the genotypes showed either susceptible or highly susceptible reaction against the nematode and maximum number of eggmasses were recorded on MH-1722 and MH-1831 genotypes. Using cultivars that are resistant to nematodes is considered a sustainable and effective strategy for nematode management. This approach is favored because it is economically viable, environmentally safe, and user-friendly. The efficacy, reliability, and stability of resistance in cultivars depend on various factors like the genetic basis for resistance in the cultivar, identification of nematode species, the population of nematodes present in the field before implementing resistance measures and interaction of the resistant cultivar and nematode species (Dababat *et al*., 2014) [5]. Resistance is determined through comparisons of genotypes (cultivars) and is often seen as a spectrum of host-nematode interactions. Resistance and susceptibility to PPNs reflect the effect of the plant on the ability against PPNs and to their reproduction (Sharma *et al*., 2006) [14]. Resistant and moderately resistant germplasm directly reduce nematode reproduction in the field. This reduction affects the overall nematode population and, as a result, the residual nematode reproduction factor under field conditions (Cook & Evans, 1987) [4]. Omwega *et al* (1989) [11] also found variation in the reproduction levels of *Meloidogyne* spp. within common bean lines due to genetic heterogeneity and out crossing. Kumar *et al*. (2021) [10] reported that root knot nematode infestation in soil could be minimized to a greater extent by using moderately resistant cultivars like FYT-7, FYT-20, FYT-22, MLT-1-13, MLT1-17, MLT-1-18, GJG-1208, Phule G-12407, Phule G-0611 and GAG-1107 of chickpea, BDN-2010-1, BDN-2011-1, KA-12-3, MA-6, MAL-13, PT-307-1, RVSA-07-10, RVSA-07-29, SKNP-1005, WRGE-97, PUSA-33, UPAS-120, GT-100, MANAK, PARAS, PUSA-855, BANAS, PUSA-991, ICPL-151 as highly resistant, GT-101 and TAT-10 as resistant and RMG-1028, ML2333, MH810 and ML-818 as moderately resistant in case of mungbean. Therefore, these genotypes can be used to select resistance genes for breeding programme along with rotations with non-host or resistant crop for the management of root knot nematode in pulses.

Table 2: Field screening of chickpea germplasm against root-knot nematode (*M. incognita*)

No.	Name of Genotype	Root-knot Index (RKI)	Reaction
1.	H15-04, H-15-23 and H-15-25	2	R
2.	H-08-18, H13-03, H-12-22, H-12-26, H-12-63, H-14-21 and H -15-27	3	MR
3.	H-13-02, H17-17, H18-18, H16-22, H-13-09, H-13-36, H-14-14, H-15-04, H-15-13, H-12-55, H17-14, H17-18, H17-23, H16-05 and HC-5	4	S
4.	H-14-11, H-15-11, H-15-18, H17-16	5	HS

Table 3: Field screening of pigeonpea germplasm against root-knot nematode (*M. incognita*)

No.	Name of Genotype	Root-knot Index (RKI)	Reaction
1.	AH15-07, AH17-27, AH17-28 and AH15-01	2	R
2.	AH14-01, AH16-21, AH15-20, AH16-07, AH16-44, AH17-17, AH16-02, AH17-01, AH16-36, AH16-40, AH16-49, AH17-03, AH16-38, VLA-1 and PADT-16	3	MR
3.	AH16-37, AH16-43, AH16-47, AH16-41, AH17-12, AH16-48 and AH17-18	4	S
4.	AH16-45 and AH16-50	5	HS

Table 4: Field screening of mungbean germplasm against root-knot nematode (*M. incognita*)

No.	Name of Genotype	Root-knot Index (RKI)	Reaction
1.	MH-1762, MH-1767, MH2-15 and MH-125	3	MR
2.	MH-1431, MH-1703, MH-1720, MH-1740, MH-1772, MH-1801, MH-1850, MH-1871, MH-421, MH-318 and MH-1142	4	S
3.	MH-1314, MH-1722, MH-1830, MH-1831 and MH-1857	5	HS

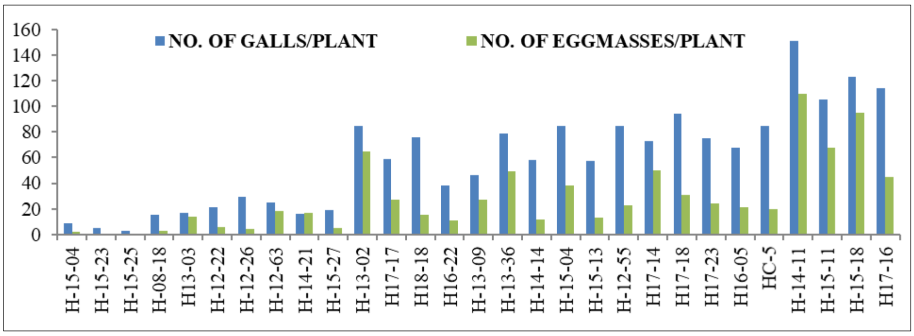

Fig 1: Overall reaction of chickpea germplasm against root-knot nematode (*M. incognita*)

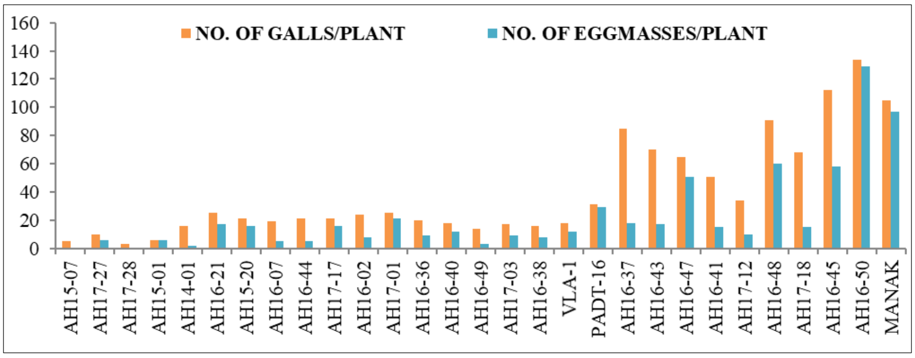

Fig 2: Overall reaction of pigeonpea germplasm against root-knot nematode (*M. incognita*)

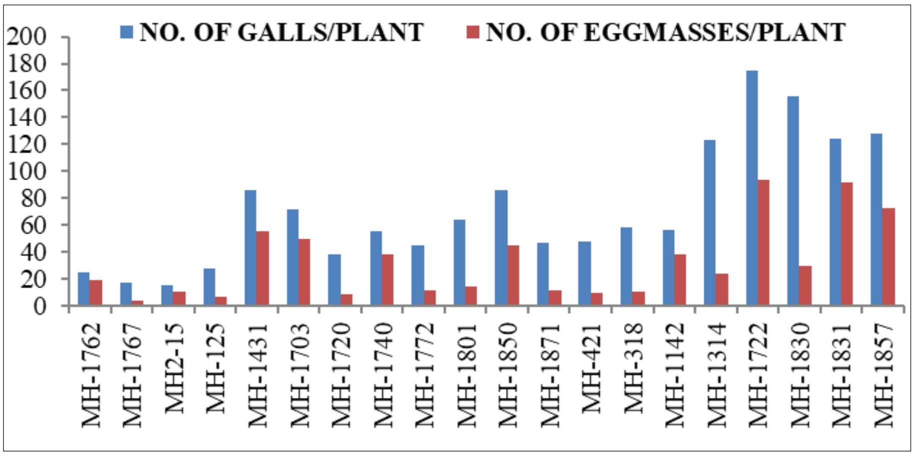

Fig 3: Overall reaction of mungbean germplasm against root-knot nematode (*M. incognita*)

Conclusion

In the present investigation, AH15-07, AH17-27, AH17-28, and AH15-01 in case of pigeonpea, H-15-04, H-15-23 and H-15-25, is case of chickpea, were found resistant and MH-1762, MH-1767, MH2-15 and MH-125 of mungbean, showed moderately resistant reaction against root-knot nematode which can be used further for resistance development.

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References

1. Bhatti DS, Jain RK. Crop cultivars resistant to nematode In: Nematode pests of crops (Eds. D.S. Bhatti & R.K. Walia), CBS publisher & Distributors, Delhi; c1994. p. 215-227.
2. Bhatti DS. Role of nematodes in crop production futuristic approaches. In: Nematode pests of crops (Eds. D.S. Bhatti & R.K. Walia), CBS publisher & Distributors, Delhi; c1992. p. 344-357.
3. Boerma HR, Hussey RS. Breeding plants for resistance to nematodes. Journal of Nematology. 1992;18(2):273-278.

4. Cook R, Evans K. Resistance and Tolerance In: Principles and Practices of Nematode Control in Crops (Ed. R.H. Brown, B.R. Kerry); c1987. p. 179-231.
5. Dababat AA, Imren M, Erginbas OG, Ashrafi S, Yavuzaslanoglu E, Toktay H, *et al*. The importance and management strategies of cereal cyst nematodes, *Heterodera* spp., in Turkey. Euphytica. 2014; 202:173-188.
6. Ferris H, Venette RC, Scow KM Soil management to enhance bacterivore and fungivore nematode populations and their nitrogen mineralisation function. Applied Soil Ecology. 2004;25(1):19-35.
7. Hussain MA, Mukhtar T, Kayani M. Characterization of susceptibility and resistance response to root knot nematode (*Meloidogyne incognita*) infection in okra germplasm. Pakistan Journal of Agriculture Science. 2014; 51:319-324.
8. Jones JT, Haegeman A, Danchin EG, Gaur HS, Helder J, Jones MG. Top 10 plant parasitic nematodes in molecular plant pathology. Molecular Plant Pathology. 2013; 14:946-961.
9. Khan MW, Salam MA. Interaction of *Meloidogyne javanica*, *Fusarium udum* and Rhizobium on pigeonpea in presence of nickel and cobalt as pollutants. Annals of Applied Biology. 1996; 116:549-556.
10. Kumar A, Patil JA, Yadav S, Ram S. Screening, confirmation and field evaluation of promising resistant germplasm of different pulses against root knot nematode, (*Meloidogyne javanica*). Journal of Environmental Biology. 2020; 41:1594-1598.
11. Omwega IO, Thomason IJ, Roberts PA, Waines JG. Identification of new sources of resistance to root-knot nematodes in Phaseolus. Crop Science. 1989; 29:1463-1468.
12. Sasser JN. Identification and host parasitic relationship of certain root knot nematodes (*Meloidogyne* spp.). Technical Bulletin. Maryland Agricultural Experiment Station; c1954. p. 31A-77.
13. Sasser JN, Freckman DW. A World Perspective on Nematology. The role of the society. *In: Vistas on Nematology*. (Ed. By Veech, J.A. and Dickson, D.W.) Society of Nematologists, Hyattsville, Maryland; c1987. p. 7-14.
14. Sharma A, Akhtar H, Syed A. Screening of field pea (*Pisum sativum*) selections for their reactions to root-knot nematode (*Meloidogyne incognita*). Journal of Zhejiang University Science. 2006; B7:209-214.
15. Walia RK, Bajaj HK. Textbook on Introductory Plant Nematology. Indian council of agricultural research; c2014.