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Studies on resistance in some pearl millet hybrids against *Meloidogyne graminicola*

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Abstract

Study was conducted to find out sources of resistance against *Meloidogyne graminicola* in some pearl millet hybrids, their parental lines (A-Line and R-lines) and Maintainer lines (B lines). In order to find exact reaction screening of germplasm lines was done for two years i.e. 2017 and 2018. Hybrids and germplasm lines were classified highly susceptible to highly resistance adopting 1-5 scales of root-knot index. Out of 36 germplasm, 8 were moderately resistant, 25 resistant and 3 susceptible (HHB 272, 94555 A and 843-22A) to *Meloidogyne graminicola* infection. All the tested R-lines were found resistant against root-knot nematode infection.

Keywords: Germplasm lines, *Meloidogyne graminicola*, pearl millet, resistance and screening

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is the fifth important cereal crop in the world and the third important food crop in India after rice and wheat. In the recent years, there has been an increasing recognition of the importance of millets as the substitution for major cereal crops. The crop is grown on the poorest soil and under harsh climatic conditions where no other crop can be grown. It is a drought tolerant and dual purpose crop of rain fed area. Incidence of *Xiphinema americanum*, *Hoplolaimus indicus*, *Paratrichodorus minor* and *Criconebella ornate* has been found on pearl millet [1]. However, some endoparasites like *Meloidogyne incognita* have also been found infecting pearl millet [2] but not much work has been done as far as *M. graminicola* on pearl millet is concerned. *M. graminicola* is primarily a pest of rice but it also attacks other cereal crops such as wheat, barley [3] sorghum, graminaceous weed and pearl millet [4] Host plant resistance is best method of nematode management. Hence, this preliminarily study was undertaken to find out sources of resistance and generate information on mechanism of resistance so that the material can be used for breeding purpose and cultivation in areas having problem of this nematodes.

Methodology

Pearl millet hybrids, their parental lines (A and R lines) and B-line shown in Table 1 were received from Bajra section Department of Genetics and Plant Breeding, CCS HAU, Hisar. The experiment was carried out twice in screen house of Department of Nematology, CCS HAU Hisar i.e. 2017 and 2018. A total of 36 entries (9 hybrids and 18 parental lines and 9 restorer lines) were subjected to screening for resistance against root-knot nematode, *Meloidogyne graminicola*. Steam sterilized soil was filled in 15 cm diameter earthen pots. Three-four seeds of each entry were sown in each pot. One week after germination, one plant per pot was retained. Inoculum was obtained by teasing the infected roots of rice. After 10 days of germination each pot was inoculated with 1000 eggs and J₂ of *M. graminicola*. The experiment was conducted in a randomized complete block design with three replications. Forty five days after inoculation, plants were uprooted carefully, roots were washed and cleaned and the number of galls per plant was counted under stereozoom microscope. Observations were recorded on the number of galls, number of eggs and final nematode population of the soil. A sample of 200 cc soil was processed and analysed by Cobb's sieving and decanting method for assessing the final nematode population in soil [5]. Germplasm lines were categorized by adopting 1-5 scale as highly resistant (1= no gall/egg mass per plant), resistant (2=1-10 galls/ egg mass per plant), moderately resistant (3= 11- 30 galls / egg mass per plant), susceptible (4= 31-100 galls/ egg mass per plant) and highly susceptible (5 = > 100 galls/egg masses per plant) as per Root-knot Index scale given by [6].

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Table 1: Pearl millet germplasm used in study

Sr. No.	Hybrids	Female parent (A-Line)	Maintainer Line (B-line)	Male parent (R-line)
1	HHB 67 Improved	ICMA 843-22	ICMB 843-22	H 77/833-2-202
2	HHB 146	ICMA 95222	ICMB 95222	HTP 94/54
3	HHB 197	ICMA 97111	ICMB 97111	HBL 11
4	HHB 216	HMS 37 A	HMS 37 B	HTP 03/13
5	HHB 223	ICMA 94555	ICMB 94555	HBL 11
6	HHB 226	ICMA 843-22	ICMB 843- 22	HBL 11
7	HHB 234	HMS 7 A	HMS 7 B	H 77/833-2-202
8	HHB 272	HMS 47 A	HMS 47 B	AC 04/13
9	HHB 301	HMS 53 A	HMS 53 B	SGP-10-107

Results: Table 2 indicated that out of nine hybrids screened; only HHB 272 was found to be susceptible and rest were found resistant against root-knot nematode, *Meloidogyne graminicola* infection. Maximum number of galls was found on HHB 272 (46.0) followed by HHB 301 (8.0). Similarly, maximum number of eggs (1596.67) followed by (298.33) was obtained in HHB 272 and HHB 216, respectively. Final soil population was found maximum in HHB 272 (381.67) followed by HHB 216 (76.67).

Among 9 A-lines 95222A, 97111A, 47A and 53A were found resistant. 94555A and 843-22A were found susceptible with (35.34) and (26.50) number of galls per plant, respectively. Maximum number of eggs per plant (1111.67) was recorded in 94555A followed by 843-22A (1105.67). Similarly, maximum final nematode population per 200 cc soil was found in ICMA 94555A followed by ICMA 843-22 (Table 3).

Table 2: Response of pearl millet hybrids to *Meloidogyne graminicola* infection (Mean of three replications)

Genotypes	Number of Galls/root system				Number of eggs and J ₂ /root system			Final Nematode Population/200 cc soil		
	2017	2018	Mean	Reactions	2017	2018	Mean	2017	2018	Mean
HHB 67 Improved	4.33	5.67	5.00	R	136.67	146.67	141.67	36.67	33.33	35.00
HHB 146	1.00	1.00	1.00	R	40.00	30.00	35.00	60.00	65.00	62.50
HHB 197	1.67	4.33	3.00	R	145.00	136.67	140.84	40.00	43.33	41.67
HHB 216	6.33	9.33	7.83	R	293.33	303.33	298.33	80.00	73.33	76.67
HHB 223	1.67	2.67	2.17	R	135.00	125.00	130.00	50.00	40.00	45.00
HHB 226	1.67	4.67	3.17	R	140.00	133.33	136.67	40.00	33.33	36.67
HHB 234	5.33	6.33	5.83	R	180.00	173.33	176.67	46.67	36.67	41.67
HHB 272	42.00	50.00	46.00	S	1533.33	1660.00	1596.67	446.67	316.67	381.67
HHB 301	7.00	9.00	8.00	R	250.00	240.00	245.00	76.67	63.33	70.00

Inoculum level: 1000 egg and J₂, S = Susceptible, R = Resistant

Table 3: Response of A-line (female parent) of pearl millet to *Meloidogyne graminicola* infection (Mean of three replications)

Genotypes	Number of Galls/root system				Number of eggs and J ₂ /root system			Final Nematode Population/200 cc soil		
	July sown	Aug. sown	Mean	Reactions	July sown	Aug. sown	Mean	July sown	Aug. sown	Mean
ICMA 843-22	24.67	28.33	26.50	MR	1110.00	1100.00	1105.00	223.33	238.33	230.83
ICMA 95222	0.67	4.67	2.67	R	70.00	370.00	220.00	40.00	120.00	80.00
ICMA 97111	1.67	2.67	2.17	R	140.00	220.00	180.00	45.00	25.00	35.00
HMS 37 A	18.33	17.33	17.83	MR	873.33	780.00	826.67	106.67	93.33	100.00
ICMA 94555	37.00	33.67	35.34	S	1150.00	1073.33	1111.67	290.00	296.67	293.34
ICMA 843-22	25.67	27.33	26.50	MR	1130.67	1080.67	1105.67	216.67	240.33	228.50
HMS 7 A	10.33	20.67	15.50	MR	630.00	1150.00	890.00	210.00	200.00	205.00
HMS 47 A	4.00	10.67	7.34	R	203.33	550.00	376.67	103.33	136.67	120.00
HMS 53 A	3.33	7.00	5.17	R	230.00	296.67	263.34	105.00	90.00	97.50

Inoculum level: 1000 egg and J₂, S = Susceptible, MR = Moderately Resistant, R = Resistant

Table 4: Response of B-line (maintainer) of pearl millet to *M. graminicola* infection (Mean of three replications)

Genotypes	Number of Galls/root system				Number of eggs and J ₂ /root system			Final Nematode Population/200 cc soil		
	2017	2018	Mean	Reactions	2017	2018	Mean	2017	2018	Mean
ICMB 843-22	12.33	13.67	13.00	MR	873.33	900.00	886.67	233.33	250.00	241.67
ICMB 95222	8.67	9.00	8.84	R	313.33	95.00	204.17	103.33	50.00	76.67
ICMB 97111	4.00	3.00	3.50	R	160.00	140.00	150.00	65.00	60.00	62.50
HMS 37 B	7.67	11.67	9.67	R	340.00	750.00	545.00	90.00	200.00	145.00
ICMB 94555	18.00	10.33	14.17	MR	786.67	890.00	838.34	220.00	210.00	215.00
ICMB 843- 22	14.00	13.33	13.67	MR	716.67	1070.00	893.34	236.67	240.00	238.34
HMS 7 B	4.67	7.00	5.84	R	390.00	470.00	430.00	110.00	120.00	115.00
HMS 47 B	25.67	29.67	27.67	MR	733.33	590.00	661.67	140.00	105.00	122.50
HMS 53 B	7.67	10.00	8.84	MR	426.67	575.00	500.84	123.33	145.00	134.17

Inoculum level: 1000 egg and J₂, MR = moderately resistant, R = Resistant

Table 5: Response of R-line (male parent) of pearl millet to the *M. graminicola* infection (Mean of three replications)

Genotypes	Number of Galls/root system				Number of eggs and J ₂ /root system			Final Nematode Population/200 cc soil		
	2017	2018	Mean	Reactions	2017	2018	Mean	2017	2018	Mean
H 77/833-2-202	3.00	4.67	3.83	R	190.00	220.00	205.00	65.00	45.00	55.00
HTP 94/54	2.67	4.00	3.34	R	105.00	120.00	112.50	70.00	50.00	60.00
HBL 11	3.00	4.67	3.84	R	160.00	170.00	165.00	80.00	80.00	80.00
HTP 03/13	10.33	5.00	7.67	R	280.00	285.00	282.50	150.00	170.00	160.00
HBL 11	2.67	5.33	4.00	R	186.67	166.67	176.67	76.67	60.00	68.34
HBL 11	2.00	4.67	3.67	R	160.00	180.00	170.00	80.00	70.00	75.00
H 77/833-2-202	4.33	6.33	5.33	R	220.00	230.00	225.00	106.67	100.00	103.34
AC 04/13	8.33	6.33	7.33	R	250.00	280.00	265.00	126.67	120.00	123.34
SGP-10-107	5.67	2.33	4.00	R	156.67	160.00	158.34	70.00	110.00	90.00

Inoculum level: 1000 egg and J₂, R= resistant

Among nine maintainer lines screened (Table 4), ICMB 843-22, ICMB 94555, HMS 47 B, HMS 53 B were found to be moderately resistant and rest were found resistant against root-knot nematode, *Meloidogyne graminicola* infection. Maximum number of galls was found on HMS 47 B (27.67). Similarly, maximum number of eggs were obtained in ICMB 843-22 (893.34) followed by ICMB 94555. Final nematode population in soil was found maximum in ICMB 843 22.

Perusal of data in Table 5 revealed that all the entries of R-line (male parent) all germplasm lines were resistant to *M. graminicola* infection. However, Maximum number of galls (7.67) was obtained in HTP 03/13 followed by AC 04/13 (7.33). Maximum number of eggs was obtained in HTP 03/13 followed by AC 04/13. Final nematode population was found maximum in HTP 03/13.

Discussion

In total among all the tested 8 were found moderately resistant, 23 germplasm, showed resistant reactions and 3 entries (HHB 272, 94555 A and 843-22A) were susceptible to *Meloidogyne graminicola*. Among susceptible germplasm lines, HHB 272 had maximum number of galls per root system followed by ICMA 94555 (35.34). In bajra, [4] found that HC-20 variety of pearl millet was highly susceptible to *M. graminicola*; it may be due to differential varietal response. In rice, [7, 8] found resistance against root-knot nematode but no such work is available on other crops. Further research needs to be carried out to elucidate the nature of resistance against *M. graminicola* in pearl millet. In a study, [3] found *H. avenae* - resistant wheat varieties (Raj MR1 and AUS 15854) gave resistant reaction whereas PBW 343 gave susceptible reaction against *M. graminicola*. Eight germplasm/varieties were also screened against *M. graminicola* and none of them was found resistant [9].

Conclusion

Parental line HTP 03/13 showed more galling in 2017 as compared to 2018. This needs further confirmation. It seems that good sources of resistance are available in pearl millet against *M. graminicola* and this crop can be used for the management of this global pest furthermore, a number of varieties and hybrids of pearl millet are cultivated in different areas which need to be tested against *M. graminicola*.

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