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Effect of different levels of root-knot nematode, (*Meloidogyne graminicola)* on the plant growth of wheat

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Abstract
An experiment was conducted in pots under glass house conditions to determine the effect of various levels of inocula of *Meloidogyne graminicola* on the growth parameters of wheat and nematode multiplication. The experiment was conducted in the Department of Plant Pathology, JNKVV, Jabalpur. In October- November, 2018. The plant were raised in 10 cm earthen pots containing 500 g steam sterilized sandy loam soil. Seven days old seedlings of wheat were exposed of various levels of inocula of *M. graminicola* viz., 10, 100, 1000 and 10,000 J_2 per pot Along with supernatent. An uninoculated control was also maintained to serve check. It was noted that a level of 1000 J_2/plant significantly reduced growth parameters of wheat and was observed to be the pathogenic level infecting plant roots. There was a gradual decrease in shoot and root length, weight of fresh and dry shoot as the level of inocula increased. Maximum numbers of galls were recorded in plants inoculated with 10,000 J_2.

Keywords: *Meloidogyne graminicola*, root-knot, nematode, wheat, plant growth parameters

Introduction
Wheat is one of the important food sources which provides 70-90 per cent calories and 66-99 per cent of protein in developing countries. Globally, wheat provides about 55 percent of carbohydrates and 20 percent calories consumed universally [4]. An area of about 30.96 million ha is occupied by the crop in India with production of 14.18 million tones [2]. Out of this the state of Madhya Pradesh occupies 5.56 million ha area with 14.18 million tones production and 31.15 q/ha. Productivity [1].

There are many factors that affect the yield but the infestation of diseases and pests are the most serious causes for low yield of irrigated and unirrigated crop. The root-knot nematode (*Meloidogyne graminicola*) is known to infect and causes serious damage to cereals, especially rice and wheat. *Meloidogyne graminicola* has now emerged as a major threat throught the world and has occupied a place of "National Pest" owing to its severity and has become a major constraint in successful wheat cultivation leading to significant loss to the crop [3, 5, 19, 14, 18]. Its first report of occurance in the state of Madhya Pradesh [15]. It has now established it self in the trible belt *viz.*, Mandla, Dindori, Kundam, Shahpura, Umaria and Anuppur exposing the crop to a serious biotic stress and severe attack on *rabi* wheat due to the adoptable nature, broad host range and ability of causing potential yield losses [11]. The diagnostic symptoms of root-knot disease are stunted growth, yellowing and gall formation on wheat roots. The degree of symptoms manifestation depends on many factors *viz,* time of infection, age of plants and load of inoculum. Abiotic factors such as nutrition, temperature, soil type and moisture etc. play important role on nematode population [20].

The information on the pathogenic behaviour of *M. graminicola* on wheat is not available. Hence present investigation was carried out to know pathogenecity of *M. graminicola* on wheat under glass house conditions.

Materials and Methods
Healthy seeds of wheat (WH1624) were surface sterlized with mercuric chloride (1:1000) and washed three times in sterile water. Seeds were then sown in ten centimeter earthen pots containing 500cm² sterilized soil. Each pots received two seeds and after germination one was retained. Seven days old seedling were used throughout the experiment. The treatment consists of an uninoculated control and five different levels of inocula as 10, 100, 1000, 10,000 second

stage juvenile (J_2) of *Meloidogyne graminicola* and supernatant. The extraction of nematodes and their disinfestation was carried out using Cobb Seiving and Decanting methods. Treatments/ level of inocula were inoculated on seven days old seedlings by gently removing the soil around the seedlings in a circumference of four centimeter and then dispersing them over the area. After appropriate inoculation, the roots were covered by fresh sterilized soil. Each treatment was replicated three times and randomized on glass house bench. The experiment was performed in complete randomyzed design.

The pots were irrigated with 100 ml fresh water every day if needed and thereafter with equal quantity of water per day as and when required. All the plant protection methods were adopted to grow healthy crop. The experiment was terminated 45 days after inoculation.

The experiment was laid out on 15/10/2018 and terminated on the 29/11/2018. The glass house temperature during this period ranged between 25°C to 35°C. The observations were recorded on plant height, fresh and dry shoot and root weight, number of galls and egg masses. The entire root system along with the soil was tappedout of the pot and the roots were washed in a container with gentle stream of water. For obtaining fresh weight, the roots were pressed gently between two pads of blotting paper and then their weight was recorded. This was followed by drying in an over at 60 °C+1 °C until constant weights.

The data was analysed statistically using ANOVA.

Results and Discussion

The effect of different levels of inoculam of *M. graminicola* on various growth parameters of wheat summerised in Table-1, plate 1 and figure-1 showed that there was a gradual stunting of plants when inoculated with *M. graminicola*. In treatment where heighest population (10,000 N/plant) of the nematode was added plant showed chlorosis and defoliation of leaves. The plant looked sick and devitalized with marked retarded growth. The plant height in this treatment was noted to be 30.00 cm. followed by 1000N (30.33cm), 100N (34.00cm) 10N (36.00cm), supernatent (40.00cm) against uninoculated control (42.33cm). Similarly there was a gradual decrease in root length as the inoculum levels increased. Maximum (20.00 cm) root length was noted in control which was significantly superior over all other treatments. Minimum (13.67cm) root length was noted with 10,000 N/plant followed by 1000 N/plant and 100 N/plant (14.67 cm). The decrease of root length (15.67cm) was additionally noted in the (10N/plant).

There was significant reduction in the fresh shoot of wheat with increase in inoculum levels. Significantly reduced shoot weight (1.30 g) was noted with 10,000 N/plant followed by 1000 N/plant (1.43 g), 100 N/plant (1.46 g), ten nematode/plant recorded (2.10 g) and supernatent/plant was recorded (2.18 g). Maximum (3.33 g) fresh shoot weight was recorded in control (uninoculated). The fresh root weight of wheat plant was adversely affected by the nematode infestation. Minimum (1.01 g) was recorded with 10,000 N/ Plant followed by 1000 N/plant (1.12 g). Reduced root weight were additionally recorded with 10 N/plant (1.54 g), 100 N/plant (1.50 g) and the supernatent (1.65 g). Maximum fresh root weight was recorded with control (2.43 g). On dry weight basis, maximum shoot weight (1.64 g) was recorded with control. Minimum shoot weight was recorded with 10,000 N/plant (0.49 g) followed by 1000 N/plant (0.53 g). the dry shoot weight recorded at 10 N/plant was (1.19 g), 100 N/plant (0.54 g) and the supernatent (1.31 g).

Similarly there was a gradual reduction in root weight on dry weight basis as the inoculum level increased. Maximum root weight (1.10g) was observed with control followed by 10 N (0.53 g), 100 N (0.42 g), 1000 N (0.37 g), and suprenatent (0.62 g) per plant. The root weight decline sharply at 10,00 N inoculum level where it was recorded to be (0.37). Minimum (13.33) root galls were noted at minimum level of inoculum (10 N/plant). The number of root galls were maximum (156.66) at 10,000 N/plant followed by 1000 N/plant (31.67), 100 N/plant (22.00) and 6.33 galls were noted in the treatment where supernatent was incorporated. The impact of various inoculum levels of *M. graminicola* on the growth of wheat revealed that the nematode mitigated the plant height drastically at higher levels i.e., 10,000 and 1000 nematodes per pot. Similarly significant reduction in root length, fresh and dry root and shoot weights, minimum root galls were observed with with the increasing levels of nematode inocula. Largest amount of nematode inoculum showed inhibitory and effect on plant development parameters of wheat. The result are in accord with the finding presented by Kumar *et al.* [12] and Jaiswal *et al.* [9] on sorghum with *M. graminicola.* Kaur [10] also recorded and considered 1000N/pot as damaging threshold level of *M. graminicola* on rice.

Pokharel *et al.* [17] who observed that *M. graminicola* reproduced multiple times more on rice than wheat. Higher reproductive factor of *M. graminicola* was observed on rice than wheat demonstrating higher rate of reproduction of this nematode in rice. The higher reproduction of the nematode may be because of the hereditary make up of the plants as well as the accessible root biomasses for nematode growth and reproduction Pokharel *et al.* [17]. Rice has a more noteworthy root mass than wheat, in this manner supporting higher nematode reproduction Gaur and Sharma [8]. Number and size of galls were bigger in case of rice compared to wheat Dabur and Taya [6]. These discoveries were in accordance with the perceptions of the present study. *M. graminicola* was reported to attack wheat and other cereal crops around the world Pokharel *et al.* [18]. Large rooted plants will permit more nematode reproduction and tolerate more damage than small rooted plants despite the latter having fewer invasion sites for the nematode.

Conclusions

In this investigation, as inoculum levels of *M. graminicola* increased, there was a significant reduced in plant growth parameters. The high level of inoculam potential of *M. graminicola* on wheat was noted to be 2 L_2/g soil.

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Table 1: Effect of different inoculam levels of *Meloidogyne graminicola* on growth of wheat

S. No.	Treatments	Plant height (cm)	Root length (cm)	Fresh weight (g)		Dry weight (g)		Fresh weight dry weight ratio	No of galls/plant
				Shoot	Root	Shoot	Root		
1	Control	42.33*	20.00	3.33	2.43	1.64	1.10	1:0.48	0.00 (1.00**)
2	Supernatant	40.00	17.33	2.18	1.65	1.31	0.62	1:0.50	6.33 (3.51**)
3	10N	36.00	15.67	2.10	1.54	1.19	0.53	1:0.47	13.33 (4.65)
4	100N	34.00	15.00	1.46	1.50	0.54	0.42	1:0.32	22.00 (5.69)
5	1000N	30.33	14.67	1.43	1.12	0.53	0.37	1:0.33	31.67 (6.62)
6	10000N	30.00	13.67	1.30	1.01	0.49	0.31	1:0.35	156.66 (13.51)
	S.Em ±	1.41	0.89	0.02	0.01	0.05	0.01	-	15.75 (4.96)
	CD at 5 %	4.44	2.79	0.07	0.04	2.62	0.03	-	49.64 (8.04)

*N = Nematodes. ** Mean of three replications,
** Figure in Parentheses are √ n+1 transformed values

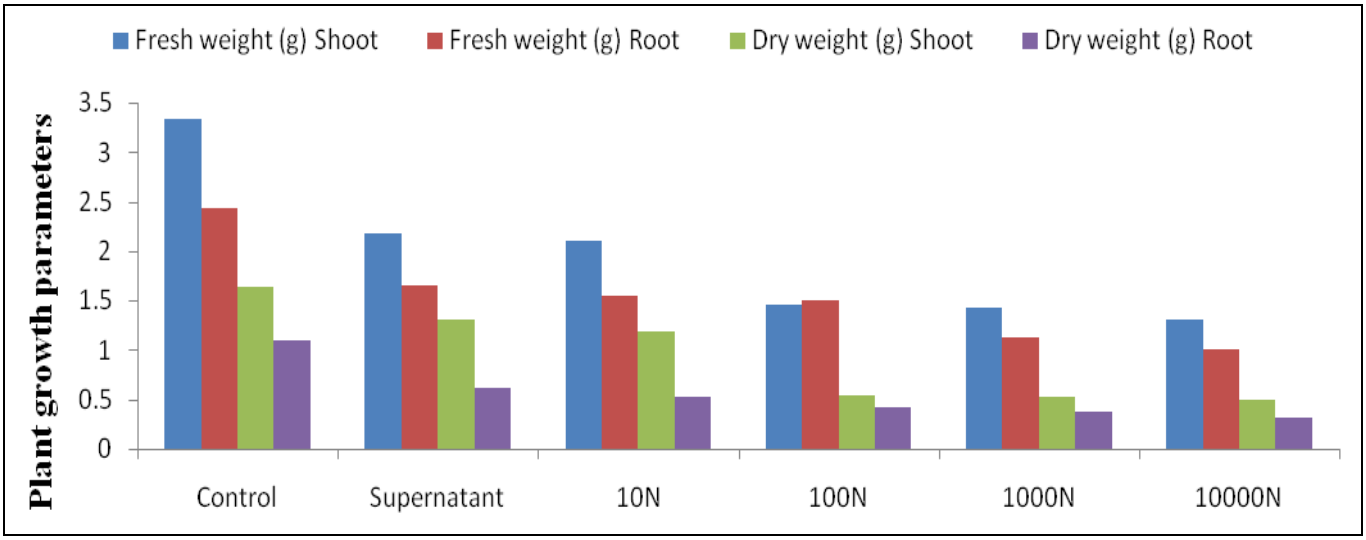

Fig 1: Effect of different levels of inocula of *Meloidogyne graminicola* on growth of wheat

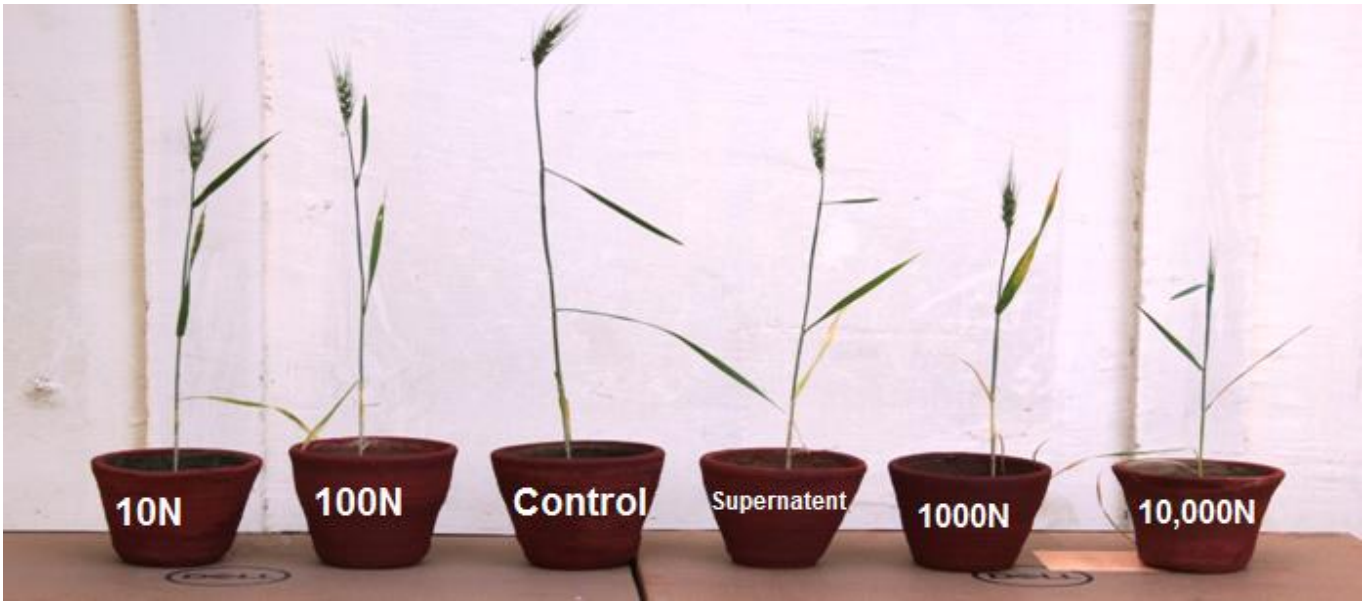

Plate 1: Effect of different levels of inocula of Meloidogyne graminicola on growth of wheat

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