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LEAF AND STEM GALLS OF BEAN NATURALLY INDUCED BY

Melcidogyne javanica

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INTRODUCTION

The root-knot nematode, Meloidogyne Goeldi, 1887, which is entirely known as a parasite of underground parts of plants, has also been found parasitizing above ground or aerial parts of different plant species. Such a behaviour is quite unusual to the species of this genus which may be responsible for its widespread occurrence and distribution throughout the world due to its adaptability to wide range of nutrient and environ mental conditions. STEINER et al. (1934) have reported stem galls extending above the soil surface on Thumbergia SDD.. Rheum rhaponticum and Begonia spp., on the first which of galls developed to enormous size. STEINER (1940) has recorded severe injury to beans resulting from infections of stems, cotyledons and leaves of seedlings germinated in soil heavily infested with root-knot nematode. LINFORD (1941) also observed galls on the hypocotyl of cowpea (Vigna sinensis Endl.) and okra (Hibiscus esculentus L.) and on both hypocotyl and cotyledons of tomato (Lycopersicon esculentum Mill.) resulting from entry of nematodes during germination.

WANG & HIGHES (1976) reported for the first time stem gall of cactus (*Mammillaria hexacantha*) naturally induced by the

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root-knot nematode *Meloidogyne incognita*. SHARMA (1976), while studying the resistance of cocoa (*Theobroma cacao*) hybrids to a root-knot nematode, *M. incognita*, under greenhouse conditions, observed gall formation on the stem at ground level (per sonal communication). Later on, SHARMA & CASTRO (1979) observed severe galling of the stem of soybean (*Glycine max* (L.) Merr. cv. UFV-1) at soil surface level followed by cracking and ultimately death of seedlings inoculated with *M. javanica* under greenhouse conditions. *M. javanica* was found to infect the bracts and bracteoles of the inflorescence of *Palisota bar teri* and causing large galls on leaves (Mac GOWEN et al., 1979).

The present paper deals with observations on natural inducement of leaf and stem galls by *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949, present in a naturally infested soil.

MATERIAL AND METHODS

Greenhouse experiment

Naturally infested soil with *Meloidogyne javanica* was used for studying the formation of leaf and stem galls on common bean (*Phaseolus vulgaris* L. cv. Rico 23) under greenhouse conditions. The soil used in this experiment was a 50% mixture of Dark Red soil (Latossolo Vermelho Escuro) plus river sand which was sieved and autoclaved before liming and fertilizer application. The soil was filled in PVC containers (7.5 cm diameter and 30 cm height with botton closed with nylon gauze) and inoculated with 30,000 eggs and larvae of *M. java nica* per container and planted to soybean (*Glycine max* (L.) Merr. cv. UFV-1).

After 45 days, plants were uplifted and the soil was thoroughly mixed for determing the larval and egg population using a method described by COOLEN (1979). The population den sity was 5.75 larvae and eggs per g of soil. The infested soil was divided in two parts, one part was autoclaved and the other part was left as such. Fifteen containers were filled with autoclaved soil and the other fifteen ones filled with infested soil making a total of 30 containers. Two uniform seeds of bean cv. Rico 23 were sown in each container. The

containers were arranged on greenhouse tables in a completely random fashion. The experiment was terminated 30 days after planting the seed.

Open-air experiment

In this experiment, only soil naturally infested with M. javanica was used. The soil was thoroughly mixed and spread over a cement bench as a layer of 20 cm height; common bean cultivar Rico 23 was sown at a close spacing of 13 cm distance and 15 seeds per meter and left for nematode multiplication.Af ter 90 days, the plants were cut at soil layer and the soil was dug up for thorough mixing before planting 20 breeding lines of common bean. Nematode populations in soil were determined by using a method described by COOLEN (1979). The avera ge of six samples was 9.35 larvae and 0.75 egg of M. javanica.

Seeds of twenty breeding lines of bean were sown ata 10 x 13 cm spacing. There were 2 replications of each breeding line with five plants per replication. Observations were made from the time of germination up to 2 weeks regarding the leaf and stem gall formation. The gall index used for evaluation was as follows: 0 - absence of galls; 1 - very light galling; 2 - moderate galling; and, 3 - severe galling.

RESULTS AND DISCUSSION

The results of the greenhouse experiment revealed that plants grown in infested soil were stunted with severe leaf galling and reduced leaf size with yellowing and finally drying up, resulting in premature death in comparison to tall green healthy plants grown in autoclaved soil. The premature death of bean seedlings was due to severe infection of stems, cotyledons and leaves by root-knot larvae present in the soil. The gall size was small resembling pimples on human skin dis tributed over the stem with 5 to 8 in a straight line giving an appearance of saw like structures on drying up (fig. 1A). Egg masses were observed on the galled surface with few egg masses in them.



Fig. 1A - Severe stem galling of common bean CV-Rico 23 showing saw-like structures after drying up.

1B - Common bean seedling CV-CNF 0017 showing severe stem galling at hypotocyl region and leaf.

The leaf galls were small yellow pin-head like struc tures surrounded by green area. Leaf galls were distributed on any part of the leaf including leaf margins. Second and. third stage larvae were found associated with severe leaf gal ling followed by vein clearing, leaf colour changing from gre en to vellow giving mottled leaf symptoms and finally falling down prematurely with any further increase in size. The leaves also showed puckering symptoms. The root-knot mematode larvae gerally occupied smaller veins than bigger with mouth parts surrounded by giant cells with granular cytoplasm. By the end of 30 days all the plants grown in infested soil dried completly whereas the control plants had a luxuriant growth.

Results of the open-air experiment are summarised in ta ble 1. Stem and leaf galling were observed in all the 20 breed ing lines. Stem galling was more severe than leaf galling. The stem galling index varied from light to very severe where as the leaf galling index in general was much lower. The occurrence of leaf galls varied from 15 to 100 per cent of plants grown in infested soil. Plant growth in general became static after 10 days and plants started dying.

The stem galling was more severe in the hypocotyl region extending up to 3.5 cm above soil surface with its maximum di ameter at stem base, varying from 0.3 cm to 0.7 cm. Such galls can be be easily called as composite, different from individual galls on stem surface which were comparatively smaller in size (fig. 1B).

The number of galls on leaf surface was very low varying from 0 to 12. Infection of midrib of leaf presented a yellowish swollen strip extending up to 0.3 cm and not a pinhead like structure which may also be called as elongated galls.

Leaf galling was more severe under greenhouse conditions than in an open air condition which may be due to high tempe rature present in the former case. Composite stem galling was not observed under greenhouse conditions which was very common in an open air experiment. Invasion of aerial parts of plants by the root-knot nematode may have been facilitated du ring the time of germination when the young embryois directly in contact with the second stage infective larvae of *Meloido*-

Table 1 - Incidence of stem and leaf gall of beans grown in soil naturally infested with *Meloidogyne javanica*. Mean of two replications (5 plants/replicate)

Breeding	Ste	m_gall	Lea	f_gall
line	Index I	ncidence(%)	Index In	cidence(%)
CNF 0017	3,0	100	3,0	100
CNF 0018	3,0	100	2,0	70
CNF 0024	3,0	100	3,0	80
CNF 0021 CNF 0025 CNF 0019 CNF 0009	2,0 2,0 1,5 2,0	95 80 65	2,0 2,0 1,5	50 45 35 70
CNF 0016	2,0	100	2,0	20
CNF 0010	2,0	100	2,0	40
CNF 0003	2,5	95	2,0	15
CNF 0020	1,5	90	2,0	40
CNF 0012	1,5	85	2,0	30
CNF 0015	1,5	100	1,0	60
CNF 0005	2,5	100	1,0	25
CNF 0004	3,0	100	2,0	50
CNF 0008	3,0	100	3,0	70
CNF 0001 CNF 0006 CNF 0013	2,5 2,0 2,5 2,5	100 100 100	2,0 2,0 3,0	25 30 25

gyne present in the naturally infested soil. At this stage, there does not seem to be much difference between the root and shoot tissue's physiology, where as the other conditions remaining constant.

ABSTRACT

This is believed to be the first report from Brasil of leaf and stem galls on common bean, *Phaseolus vulgaris* L. cv. "Rico 23" naturally induced by a root-knot nematode, *Meloido*-

gyne javanica (Treub, 1885) Chitwood, 1949. Severe injury to common bean due to infection of stems, cotyledons of seedlings germinated in heavily nematode infested soil resulting in pre mature death was observed under greenhouse conditions. In general galls were small, resembling saw-tooth like structures distributed over the stem in a sequence of 5 to 8 in a strai ght line. Egg masses containing few eggs and second and third stage larvae were found on these galls. In open air conditions, galls were much larger occupying 3 to 4 cm of stem surface above soil layer in 20 common bean breeding lines. Colour of the infected leaves changed from greenish to pale yellow followed by premature leaf fall. Infected leaves presented puckring symptoms. The larvae in general were at the intersection of leaf veins and veinlets with mouth surroounded by giant cells containing granular cytoplasm. Stem galling was also. observed in other hosts such as soybean, cowpea and hybrid co coa.

RESUMO

Supomos ser este o primeiro relatório originado no Brasil a respeito de galhas de folhas e caule do feijoeiro, Phase olus vulgaris L. cv. 'Rico 23', naturalmente induzido por Meloidogyne javanica (Treub, 1885) Chitwood, 1949. Foram observados, em condições de estufa, danos extremamente severos aos feijoeiros, resultando na morte prematura dos mesmos, devido à infecção do caule, cotilédone e mudas germinadas em solos extremamente infestados. As galhas eram pequenas, semelhantes a pequenas protuberâncias parecidas com dentes de serra, distribuídas em següência de 5 a 8 em linhas retas. Foram observadas ootecas com poucos ovos, bém como larvas de segundo а terceiro estádio, associadas às saliências das folhas, com mu danças de cor verde amarelo, causando a queda prematura das fo lhas. Em condições de campo, o tamanho de galhas foi maior ocu pando 3 a 4 cm do caule acima do nível do solo nas 20 linha gens do feijoeiro. As folhas mostravam sintomas de rugosidade. As larvas em geral ocupavam as intersecções das veias meno res, com a boca das mesmas circundadas de celulas gigantes com citoplasmas granulados. As galhas também foram observadas nos caules de outros hospedeiros tais como, soja, feijão de corda e cacau hibrido.

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