Piper aduncum helps fusariosis control and growth promotion in black pepper.

Ruth L. Benchimol[1]; John C. Sutton[2]; Cleber N. Bastos[3]; Moacyr B. Dias-Filho[1]

[1]Embrapa Amazônia Oriental, Caixa Postal 48, 66017-970, Belém, PA, e-mail: rlinda@cpatu.embrapa.br; [2]University of Guelph - Ontario Agricultural College, N1G 2W1, Guelph, Ontario, Canada; [3]CEPLAC-SUPOR, Caixa Postal 1801, 66635-110, Belém, PA, Brazil.

ABSTRACT

Black pepper (*Piper nigrum*) fusariosis, caused by *Fusarium solani* f. sp. *piperis* Albuq. (FSP), is a major root disease in Amazon region. Based on previous studies that show an inhibitory effect of *Piper aduncum* L. (PAD) on FSP, we hypothesized that PAD leaves (PADL) would suppress fusariosis. Soil amendment with 1.5 and 3.0% of PADL reduced black pepper mortality by FSP in 66.7 and 83.3%, respectively. Amendment at the 3.0% level increased plant biomass production at all treatment combinations. Plant biomass was preferentially allocated to foliage in plants grown in amended soils, under all treatment combinations. No difference in the photosynthesis rate could be detected in plants grown in noninfested/amended soils, compared to those in noninfested/nonamended soil. We concluded that PADL have potential to suppress fusariosis and help black pepper growth.
Keywords: *Piper nigrum;* Piperaceae; *Fusarium solani* f. sp. *piperis*; soil amendment.

RESUMO

Piper aduncum auxilia no controle da fusariose e no desenvolvimento de mudas de pimenteira-do-reino.

A fusariose, causada por *Fusarium solani* f. sp. *piperis* (FSP), é a principal doença da pimenteira-do-reino (*Piper nigrum*) na Amazônia. Com base em estudos anteriores, que evidenciaram o efeito inibitório de *Piper aduncum* (PAD) sobre FSP, hipotetizou-se que as folhas de PAD (FPAD) poderiam suprimir a fusariose. A adição de 1,5 e 3,0% (m/m) de FPAD ao solo reduziu a mortalidade das plantas em 66,7 e 83,3%, respectivamente, aos 90 dias. FPAD a 3,0% aumentou a produção de massa seca das plantas em todos os tratamentos. A biomassa das plantas foi preferencialmente alocada para as folhas nos solos adicionados de FPAD. Não foi detectada diferença significativa na taxa de fotossíntese líquida das plantas nos tratamentos não infestados com o patógeno, adicionados ou não de FPAD. Concluiu-se que FPAD tem potencial para suprimir a fusariose e para auxiliar no desenvolvimento de mudas de pimenteira-do-reino.

Palavras-chave: *Piper nigrum*; Piperaceae; *Fusarium solani* f. sp. *piperis*.

Fusariosis, caused by *Fusarium solani* (Mart.) Sacc. f. sp. *piperis* Albuq. (FSP) is a major disease of black pepper (*Piper nigrum* L.) in Brazil. Based on previous studies that show an inhibitory effect of *Piper aduncum* L. (PAD) on FSP (Bastos, 1997; Benchimol *et al.*, 2001), it is hypothesized that PAD leaves would suppress fusariosis when used as soil amendment.

MATERIAL AND METHODS

Fresh PAD leaves (FPAD) were oven dried, ground, incorporated into natural or autoclaved Oxisol at 1.5 or 3% (w/w), and incubated for 45 days in pots in a screen house. Soil was infested with FSP at a rate of 20 mL spore suspension (4×10^5 conidia mL^{-1}) kg^{-1} of soil and incubated for15 days. Two-month old rootstocks of black pepper, cv. Guajarina, were planted in the soils. Plant survival, soil microbial biomass (SMB), plant biomass (PBP) production and allocation (PBA), and photosynthesis rates (PSR) were estimated.

RESULTS AND DISCUSSION

Mortality, at 90 days, was reduced by 66.7 and 83.3% in soil amended with 1.5 and 3.0%. (Fig.1). This suggests that some compounds present in PAD leaves, including the essential oils (Maia *et al.*, 1998), which is known to cause *in vitro* inhibition of mycelial growth of FSP and other plant pathogens (Bastos, 1997), could be inhibiting the pathogen in the soil.

SMB was more representative in natural soil, independent of the FPAD addition. It tended to increase in the presence of FSP in both soils, except for 1.5% of FPAD, even so it was only been possible to detect significant difference in natural soil, without the addition of this residue (Fig. 2). The correlation between plant survival and the SMB was significant, but weak and negative ($r = -0.43$; $p = 0.034$), suggesting that microorganisms were not directly responsible for the reduction in plant mortality.

Amendment at the 3.0% level increased biomass production at all treatment combinations (Fig 3), due to the addition of nutrients to soil, especially K, which is found in high amounts in PAD leaves and is one of the most requested nutrients by black pepper, and N, which can help reducing fusariosis. At the 1.5% level, this trend was maintained, however, in the autoclaved/infested treatment, plant dry mass was reduced by 27%. That reduction was not statistically significant.

Plant biomass was preferentially partitioned to foliage in plants grown in amended soils, under all treatment combinations (Fig. 4). This may suggest a characteristic of high

nitrogen supply, which decreases the need of root production for nutrient uptake (Fitchner *et al.*, 1995), considering that the C/N ratio of FPAD was around 4.19 (Benchimol, 2002).

No difference in the PSR could be detected in plants grown in noninfested/amended soils, compared to those in noninfested/nonamended soil. PSR values for plants in infested/amended soil were significantly lower than in plants grown in infested/nonamended soil (Fig. 5). We concluded that FPAD has potential for use as a soil amendment to suppress fusariosis and to promote growth in black pepper.

REFERENCES

BASTOS, C. N. **Fito patologia Brasileira**, v. 22, n. 3, p. 441-443. 1997.

BENCHIMOL, R. L Efeito da casca de caranguejo e de resíduos de *Piper aduncum* no controle da fusariose e no desenvolvimento de mudas de pimenteira-do-reino. Belém: UFPA. **Tese de Doutorado**. 120 p. 2002.

BENCHIMOL, R.L.; SUTTON, J. C.; BASTOS, C.N.; DIAS-FILHO, M. B. **Canadian Journal of Plant Pathology** 23: 194, 2001.

FICHTNER, K.; KOCH, G.W.; MOONEY, H.A. Photosynthesis, storage and allocation. In: SCHULZE, E.D.; CALDWELL, M.M. (eds.). **Ecophysiology of Photosynthesis**. Berlin: Springer, 1995. p.132-146.

MAIA, J. G. S.; ZOOHBY, M.G.B.; ANDRADE, E.H.A; SANTOS, A. S.; SILVA, M. H. L. da; LUZ, A. I. R.; BASTOS, C. N. **Flavor and Fragrance Journal**, v. 13, n. 4, p. 269-272. 1998.

ACKNOWLEDGMENTS

The authors thank Brazilian Agricultural Research Corporation - Embrapa, Japan International Corporation Agency - JICA; Federal University of Pará - UFPA and University of Guelph for the support on this research.

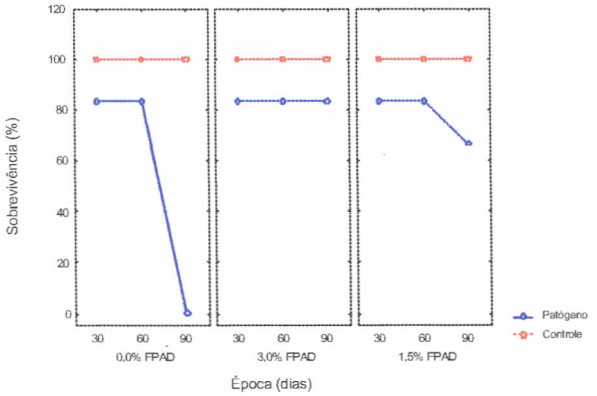

Figure 1- Black pepper plant survival in soil infested with FSP and amended with FPAD.

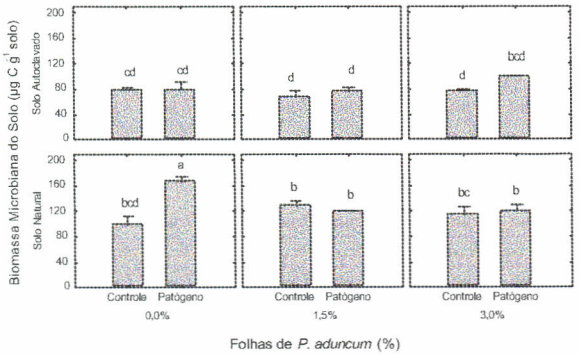

Figure 2- Soil microbial biomass in soil amended with FPAD. Values are averages (+ SE)).

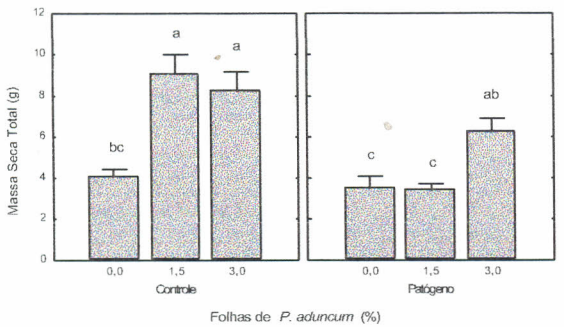

Figure 3- Black pepper total dry mass production in soil amended with FPAD and infested with FSP.

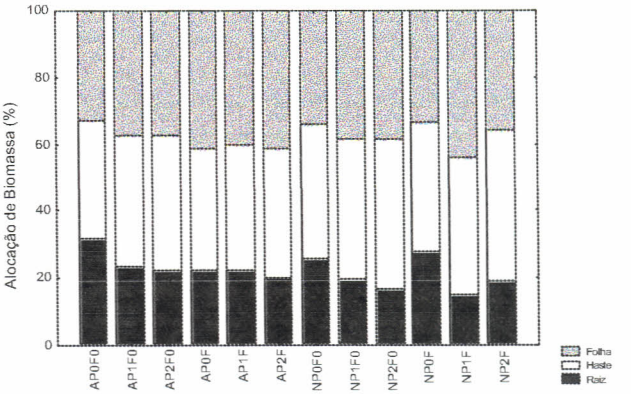

Figure 4- Biomass allocation in black pepper plants grown in soil amended with FPAD. A= autoclaved soil; N= natural soil; P0= no amendment; P1= FPAD 1,5%; P2= FPAD 3,0%; F0= no pathogen; F= pathogen.

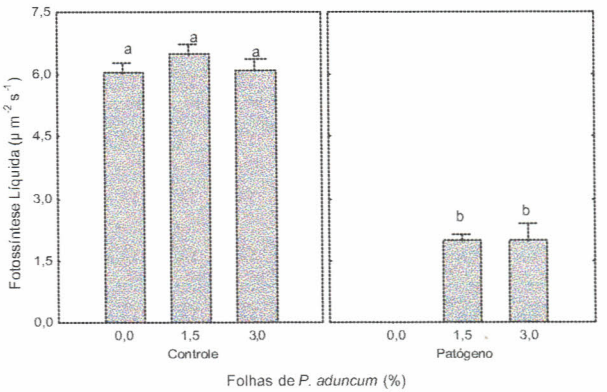

Fig. 5- Photosynthesis rate of black pepper plants grown in soil amended with FPAD.