EFFECTS OF CARBOSULFAN ON PINEAPPLE (*ANANAS COMOSUS* (L.) MERR.) GROWTH[1]

NELSA MARIA PINHO GUEDES[2], RAUL NARCISO CARVALHO GUEDES[3] and MARCELO COUTINHO PICANÇO[4]

ABSTRACT - The effect of the systemic insecticide carbosulfan on the growth of pineapple, transplanted from *in vitro* cultures, was observed in a greenhouse experiment. Three doses of carbosulfan (10, 25 and 50 ppm) were applied along with a control (no insecticide). The plants were harvested at 30, 60, 90, 120 and 150 days after being transplanted. The average leaf length (ALL), average root length (ARL), shoot dry weight (SDW) and root dry weight (RDW) were assessed. Regression analysis did not show any significant difference between doses and days of development in what concerns ALL, but a positive effect of carbosulfan was observed in the evaluations of ARL, SDW and RDW, carried out at 120 and 150 days after the transplantation. The best results were obtained with the application of 25 ppm of carbosulfan.

Index terms: systemic insecticide, plant growth.

EFEITOS DO CARBOSULFAM NO CRESCIMENTO DO ABACAXIZEIRO (*ANANAS COMOSUS* (L.) MERR.)

RESUMO - O efeito do inseticida carbosulfam no crescimento do abacaxizeiro, transplantado de cultura *in vitro*, foi observado em experimento realizado em casa de vegetação. Foram aplicadas três doses de carbosulfam (10, 25 e 50 ppm), além do controle (sem inseticida). As plantas foram colhidas aos 30, 60, 90, 120 e 150 dias depois do transplantio. Foram avaliados o comprimento médio de folhas (CMF), comprimento médio de raízes (CMR), peso seco de folhas (PSF) e peso seco de raiz (PSR). Análises de regressão não mostraram diferença significativa entre doses e tempo de desenvolvimento no que se refere a CMF, mas um efeito positivo do carbosulfam foi observado em avaliações de CMR, PSF e PSR, feitas aos 120 e 150 dias após o transplantio. Os melhores resultados foram obtidos com a aplicação de 25 ppm de carbosulfam.

Termos para indexação: inseticida sistêmico, crescimento de vegetal.

INTRODUCTION

The objective of insecticide usage in plants is to protect them against the damage caused by insect pests. However, it has been verified that some insecticides, mainly systemics, influence the plant growth and production (Pless et al., 1971; Lee, 1977; Olofinboba & Kozlowski, 1982; Della Lucia & Chandler, 1985; Reddy et al., 1986; Araya et al., 1988; Barrigossi et al., 1988a, 1988b; Calafiori et al., 1988; Cranshaw & Thorton, 1988). Little is known about the direct effect of systemic insecticides on the biochemistry and physiology of plants which influence growth and quality of crop plants.

The application of carbosulfan against soil termites and pineapple scales is still not recommended in Brazil. Nevertheless, closely related insecticides are used and the possibility of the future use of carbosulfan in pineapple is under consideration since a controlled release formulation for this insecticide is available which shows promise in the control of soil termites, scales, aphids and trips (Resende et al., 1993). Due to the great potential in the use of

[1] Accepted for publication on February 9, 1996

[2] Eng[a]. Agr[a]., M.Sc., Dep. Fitotecnia, Universidade Federal de Viçosa, CEP 36570-000 Viçosa, MG.

[3] Eng. Agr., M.Sc., Dep. Biol. Animal, Univ. Fed. de Viçosa.

[4] Eng. Agr., D.Sc., Dep. Biol. Animal, Univ. Fed. de Viçosa.

carbosulfan against pineapple pests in Brazil and due to the favorable effects of some systemic organophosphate insecticides on some crops, an experiment was carried out to evaluate the effects of carbosulfan on the pineapple growth. This may also provide primary information for future physiological studies about this subject.

MATERIAL AND METHODS

Pineapple explants of the cultivar Smooth Cayenne cultivated *in vitro* as described by Mathews & Rangan (1979), without roots, were selected by size (12 cm) and planted in washed sands in 0.5 l vases. Different doses of carbosulfan MARSHAL 50G® (10, 25 and 50 ppm) were applied right after the transplantation along with a control, to each set of vases. Murashige & Skoog (1962) nutrient solution was applied every week using half of the concentration in the first two months of the experiment and the normal concentration subsequently due to the height of the plants. In order to prevent insecticide loss, the nutrient solution was placed in glass dishes on which the vases were placed. The plants were harvested at 30, 60, 90, 120 and 150 days after transplantation.

The experimental design was a split-plot-design with the doses of carbosulfan as the main plots and days of harvesting as the sub-plots. There were two replications for each treatment. After each harvest the root system of each plant was separated from the shoot and average length of both was measured. They were then dried at 80°C, under air circulation, until constant weights were obtained. Regression analysis of the data was performed with the coefficient of the equations being tested at 10% of probability. The regression curves were plotted for each insecticide concentration and the ratios between shoot and root dry weight and average leaf and root length were calculated to verify if the carbosulfan has higher effect over the shoot or root growth.

RESULTS AND DISCUSSION

No significant difference was detected among the insecticide doses for each harvest in what concerns average leaf length (ALL) (Fig. 1). Shoot dry weight (SDW) (Fig. 2) showed significant differences among doses and also among harvests. Plants harvested at 30 and 60 days showed SDW similar to the control (no insecticide), and with further growth the SDW increased along with the increase of the insecticide doses, reaching better results with 25 ppm

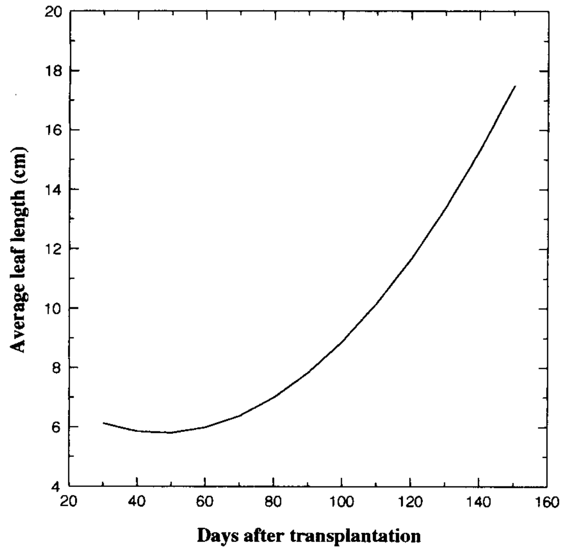

FIG. 1. Increase in pineapple average leaf length with time. ($Y=8.2250-0.1032X+0.0011X^2$, $R^2=0.75$; Y=average leaf length, X=days after transplantation).

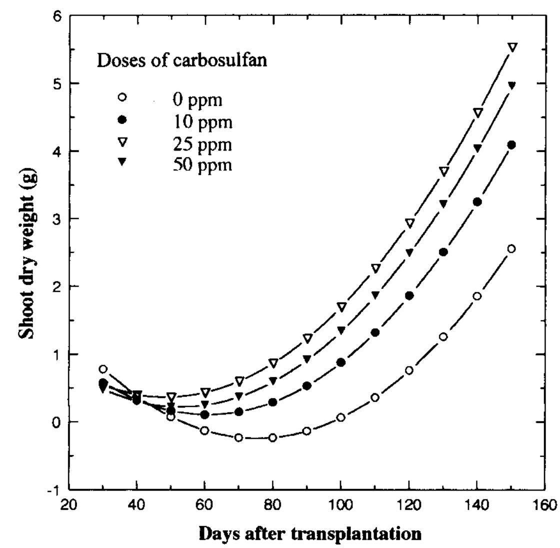

FIG. 2. Increase in shoot dry weight of pineapple cultivated under four doses of carbosulfan.($Z=2.5852 - 0.0752X + 0.0005X^2 - 0.0645Y + 0.0009Y^2 + 0.0017XY - 0.000025XY^2$, $R^2=0.87$; Z=shoot dry weight, X=days after transplantation, Y=dose of carbosulfan).

of carbosulfan and slightly declining with 50 ppm. This seems to be due to an optimal dilution of the insecticide at 25 ppm with the pineapple shoot growth.

The beneficial effect of systemic insecticides in shoot growth has also been reported with other plants. Calafiori et al. (1988) observed a better growth of citrus plants when they were treated with the systemic carbamate aldicarb and this positive effect led to a higher fruit production. Similar effects were also reported in potato plants treated with the same insecticide (Cranshaw & Thorton, 1988). Barrigossi et al. (1988a, 1988b) verified a positive effect of the systemic organophosphate phorate on the growth and development of bean plants. Lee (1977) reported a synergistic effect of carbofuran metabolites and indole-3-acetic acid (IAA) on pea growth. In addition, Lee (1977) also verified an inhibitory effect of carbofuran metabolites on enzymatic degradation of IAA on pea plants. Pless et al. (1971) verified in burley tobacco that carbofuran and disulfoton-treated plants grew to maturity earlier and produced greater yields than untreated tobacco. Nevertheless, negative effects of some systemic insecticides have also been reported in pine trees (Olofinboba & Kozlowski, 1982), peas (Reddy et al., 1986) and beans (Della Lucia & Chandler, 1985).

The average root length (ARL) of the plants of all treatments harvest at 30 days after transplantation was similar, but with further growth a higher increase in ARL was observed with the application of carbosulfan (Fig. 3). Root dry weight (RDW) (Fig. 4) at 30, 60 and 90 days after transplantation was similar for all treatments, but at 120 and 150 days a positive effect of carbosulfan was also verified. The best results of root growth were obtained with 25 ppm of the insecticide. The positive effect of another systemic insecticide (phorate) in root development was also reported in bean plants (Barrigossi et al., 1988b), but negative effects of systemic insecticides are similarly known in wheat and oat (Araya et al., 1988).

No significant relationship between the SDW and RDW and between the ALL and ARL was observed, suggesting that carbosulfan mostly affects plant

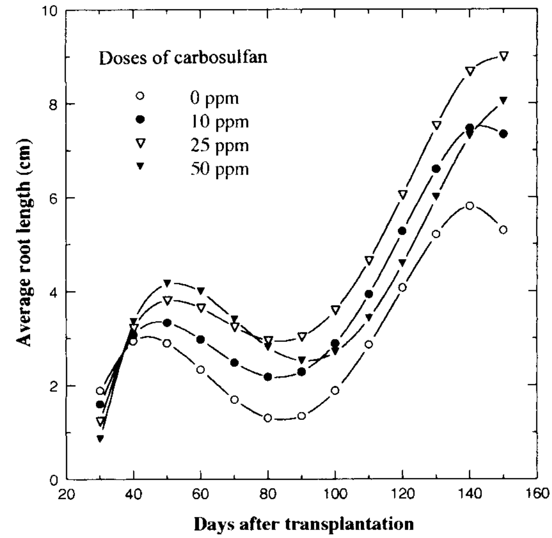

FIG. 3. Increase in average root length of pineapple cultivated under four doses of carbosulfan. (Z=-15.523686 + 1.122183X - 0.023341X^2 + 0.000192X^3 - 0.000000534X^4 - 0.258608Y + 0.001186Y^2 + 0.010346XY - 0.000032793XY^2 -0.000103X^2 + 0.000000375X^3Y, R^2=0.93; Z=average root length, X=days after transplantation, Y=dose of carbosulfan).

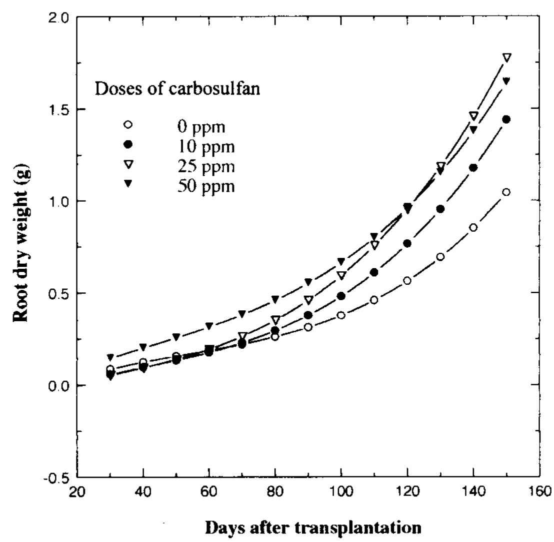

FIG. 4. Increase in root dry weight of pineapple cultivated under four doses of carbosulfan. (Z=-0.0929 + 0.0084X - 0.0001X^2 + 0.00000063X^3 + 0.0016Y -0.000017Y^2 - 0.0003XY + 0.000006XY^2 + 0.000004X^2Y - 0.00000007X^2Y^2, R^2=0.89; Z=root dry weight, X=days after transplantation, Y=dose of carbosulfan).

growth rather than favoring only shoot or root growth. The evaluations at 120 and 150 days after transplantation showed curves with more defined patterns than evaluation at 30, 60 and 90 days.

The effect of systemic insecticides on plant growth seems to be quite variable depending on the plant species, the soil type and fertility, the insecticide used and dose applied (Pless et al., 1971). The causes of such variations deserve additional studies and can be important specially when positive effects are detected, because they may favor the control of insect-pests and may also be useful in increasing plant yield and favoring *in vitro* propagation or field adaptation of fruit plants through the synergistic effect of the insecticide plus hormone in growth promotion or counteracting the inhibitory effect on enzymatic degradation of growth hormones on plants. The results reported here do not provide any explanation for why carbosulfan is able to promote pineapple growth, but since carbosulfan is an insecticide derived from carbufuran via the replacement of hydrogen atom on the carbamoyl nitrogen by a biochemically removable group (Eto, 1990), their mechanism of induction of plant growth is probably similar, if not the same.

CONCLUSIONS

1. Carbosulfan at 25 ppm provides the best result of pineapple plantlets growth at 120 and 150 days.
2. Carbosulfan presents benefic effect in shoot and root growth without favoring the isolated growth of anyone of these.

REFERENCES

ARAYA, J.E.; FOSTER, J.E.; ROBERTS J.J. Effect of seed treatments with systemic insecticides on germination of selected wheat and oat cultivars. **Turrialba**, v.38, p. 246-249, 1988.

BARRIGOSSI, J.A.F.; LOPES, N.F.; CHANDLER, L. Resposta fisiológica do feijoeiro (*Phaseolus vulgaris* L.) ao forate e suas consequências entomológicas. I. Análise de crescimento e conversão da energia solar. **Revista Ceres,** v.35, p.327-340, 1988a.

BARRIGOSSI, J.A.F.; LOPES, N.F.; CHANDLER, L. Resposta fisiológica do feijoeiro e suas consequências entomológicas. II. Crescimento, morfologia, partição de assimilados e produção de matéria seca das plantas. **Revista Ceres,** v.35, p.341--354, 1988b.

CALAFIORI, M.H.; FORNER, M.A.; JUNQUEIRA, F.M.A.; BONFANTE, J.A.; GUELERE, E.A.; SCHMIDT, H.A.P.; GRANDO, F.I.; ZAMBON, S. Influência do uso de inseticida sistêmico de solo no desenvolvimento da laranja pera em Espírito Santo do Pinhal, SP. **Ecossistema**, v.13, p.114-120, 1988.

CRANSHAW, W.S.; THORTON, M.K. Effects of systemic insecticides on potato growth and their interaction with metribuzin. **American Potato Journal**, v.65, p.535-541, 1988.

DELLA LUCIA, T.M.C.; CHANDLER, L. Tabela de vida das culturas aplicadas as pragas de *Phaseolus vulgaris* L. sob tratamento com carbofuran em quatro níveis de adubação NPK. **Revista Ceres**, v.32, p.227-251, 1985.

ETO, M. Biochemical mechanisms of insecticidal activities. In: BOWERS, W.S.; EBING, W.; MARTIN, D.; WEGLER, R. (Eds.) **Chemistry of plant protection**, v.6. Berlin: Springer-Verlag, 1990. p.65--107.

LEE, T.T. Promotion of plant growth and inhibition of enzymic degradation of indole-3- acetic acid by metabolites of carbofuran, a carbamate insecticide. **Canadian Journal of Botany**, v.55, p.574-579, 1977.

MATHEWS, V.H.; RANGAN, T.S. Multiple plantlets in lateral bud and leaf explant *in vitro* cultures of pineapple. **Scientia Horticulturae**, v.11, p.319-328, 1979.

MURASHIGE, T.; SKOOG, F. A revised medium for rapid growth and bioassays with tobacco tissue cultures. **Physiologia Plantarum**, v.15, p.473-497, 1962.

OLOFINBOBA, M.O.; KOZLOWSKI, T.T. Effects of three systemic insecticides on seed germination and growth of *Pinus halepensis* seedlings. **Plant and Soil**, v.64, p.255-258, 1982.

PLESS, C.D.; CHERRY, E.T.; MORGAN JUNIOR, H. Growth and yield of burley tobacco as affected by two systemic insecticides. **Journal of Economic Entomology**, v.64, p.172-175, 1971.

REDDY, T.M.; GUPTA, A.K.; VARSHNEY, M.L. The effect of pesticides on plant growth, nodulation, nitrogen fixation and protein content in fresh peas (*Pisum sativum L.*). **Pesticides**, v.20, p.36-38, 1986.

RESENDE, V.F.; NOGUEIRA, P.B.; ZANUNCIO, J.C.; GUEDES, R.N.C. Avaliação do carbossulfan, em liberação controlada, para proteção de mudas de eucalipto contra cupins de solo. **Revista Árvore**, v.17, p.10-15, 1993.