Journal of Food Technology 4 (1) : 32-36, 2006


# Effect of Chlorpyrifos on Oil, Protein, Minerals and Antinutritional Factors of Cottonseeds

Gammaa A. Osman, A.I. Mustafa and A.O. Abdelbagi
Faculty of agriculture, University of Khartoum, Khartoum north 13314, Shambat, Sudan

**Abstract:** Two Field experiments were carried out during the season 2002 / 2001 and 2001 / 2002 to investigate the effect of the insecticide Chlorpyrifos on cottonseed quality of Barakat-90 and Barac-67 cultivars. Three concentration levels of this insecticide were applied on field grown cotton. Oil, protein, minerals content were determined as well as the antinutritional factors content of cottonseeds. The results showed significant increase in cottonseed oil of Barakat-90 as influenced by different levels of treatments. While no significant difference was observed in Barac-67. Protein content increased significantly in cottonseeds of both cultivars. In contrast significant reduction in tannin content was observed for both cultivars, while no significant change was noticed in phytic acid for Barac-67 cultivar. Moreover the change in minerals of the cotton seeds showed no consistent pattern as influenced by different treatments.

**Key words:** Chlorpyrifos, cottonseed, oil, protein, tannin. phytic acid, minerals

## INTRODUCTION

Cotton (*Gossypium* sp.)is one of the major cash crops grown in Sudan. Right from seed germination to maturity, this crop is heavily attacked by many serous pests. Insecticides from different chemical classes are generally used to control these pests[1]. Although the primary effect of these insecticides is supposed to be on the insects, some of these chemicals may have side effect on the treated plants These effect may be directly through their interaction with biochemical and physiological pathways[2] or indirectly by the reduction of the effects of the insects on the plants physiology and biochemistry[3] Many studies were carried out to investigate the effect of different pesticides on the different biochemical constituents of leaves, fruits and seeds of many horticultural and fields crops[2,4,5].

The objective of this study was to investigate the changes in cottonseeds oil, protein, minerals and anti-nutritional factors, in response to the treatment with an organophosphorus insecticide chlorpyrifos which is commonly used in irrigated cotton in Sudan.

## MATERIALS AND METHODS

The seeds of two cotton cultivars, Barakat-90 and Barac-67, were obtained from cotton breeding department, agricultural Research Corporation. The insecticide chlorpyrifos was purchased from local market. Chlorpyrifos analytical standard was obtained from the pesticides formulation laboratory, Agricultural Research Corporation.

Two successive field experiments were carried out during the seasons 2002 / 2001 and 2001 / 2002 in the research farm of the Faculty of Agriculture, University of Khartoum, Shambat. The experimental area of both experiments was divided into 24 plots, the area of each plot was 5x5 $m^2$, each plot consists of five ridges, the length of each was four meters, spacing between ridges was 70 cm , and between holes was 50 cm. The seeds of two cotton cultivars, Barakat-90 and Barac-67, were sown on the 7th day of August. The experiments were irrigated weekly and fertilized with urea at a rate of 60 Kg / feddan, five weeks after sowing. Thinning, weeding and other cultural practices were carried out as recommended[6]. The insecticide chlorpyrifos was applied at three concentration, recommended dose, 1.5 and two folds the recommended dose. Treatments were replicated three times in a randomized complete block design .Samples from each plot were harvested manually.

The harvested samples were delinted mechanically, however, the delinted seeds of Barac-67, were treated with 50% aqueous sulphuric acid to remove the fuzz following the procedure described by[7]. The seeds were milled, mixed properly and for chemical analysis.

crude oil. Total crude protein of cotton seeds samples were estimated according to Official Methods of analysis[8], Calcium, sodium, potassium, iron, copper and manganese were estimated in mg/ 100 g by atomic absorption spectrophotometer ( Perkin Elmer model 3110) according to the method described by[9]. Tannin content of cotton seeds samples was estimated using the modified vanillin- HCl in methanol method described by [10] using spectrophotometer ( Pye unicam sp6- 550) at 480 nm.

**Statistical analysis:** Results were statistically analyzed using General Linear Model Procedure described by[11]. Duncan's Multiple Range Test was used for means separation.

## RESULT AND DISCUSSION

Figures 1 and 2 show the effect of different levels of treatments on the cottonseed oil content of Barakat-90 and Barac-67 cultivars, in the first and second seasons. The results indicated that, oil content of cottonseed of both cultivars in the first season, was significantly higher than the untreated control. However, in the second season, no significant differences was observed, with exceptions of the third level .These findings are not in agreement with those obtained by[12], who reported that application of pesticides usually causes reduction in cottonseed oil content. In addition to that, it was reported that most organophosphorus insecticides inhibit lipid biosynthesis in plant tissues[13]. The oil content of Barakat-90 cultivar in both growing seasons with all treatments was significantly higher than that of Barac-67 cultivar. This may be attributed to genetic factors. Palm *et al.*,[14] reported that variety and environment have a highly significant influence on cottonseed oil. Moreover, found that *G. hirsutum* seed oil content was significantly higher than of *G. barbadense* variety.


$C_1$: Control , $D_{11}$: Recommended dose of insecticide, $D_{12}$: 1.5 fold dose of insecticide, $D_{13}$: Double dose of Insecticide (Barakat –first season),$D_{21}$: Recommended dose of insecticide, $D_{22}$: 1.5 fold dose of insecticide, $D_{23}$: Double dose of insecticide (Barac-First season) $C_3$: Control , $D_{31}$: Recommended dose of insecticide, $D_{32}$: 1.5 fold dose of insecticide, $D_{33}$: Double dose of insecticide (Barakat – second season), $C_4$: Control , $D_{41}$: Recommended dose of insecticide, $D_{42}$: 1.5 fold dose of insecticide, $D_{43}$: Double dose of insecticide (Barac –second season),

Fig. 1: Effect of Insecticide treament on oil content of cottonseeds

Effect of different levels of chlorpyrifos, on protein content of Barakat-90 and Barac-67 cultivars in the first and second seasons, is shown in Fig 2 and 3. Protein content results of all treatments of both cultivars, in the first season, were significantly higher than that of the control, except for the second a n d third level in Barac-67 in the second season. These results agree with those of Chakraborti *et al.*,[15] who observed that the


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Fig. 2: Effect of insecticide treament on protein content seeds

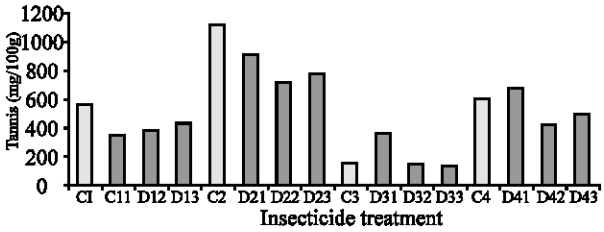


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Fig. 3: Effect of insecticide treament on tennins content of cotton seeds

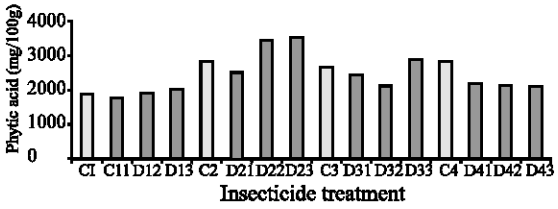


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Fig. 4: Effect of insecticide treament on phytic acid content of cottonseeds


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Fig. 5: Effect of insecticide treament on calcium content of cottonseeds


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Fig. 6: Effect of insecticide treament on sodium content of cottonseeds

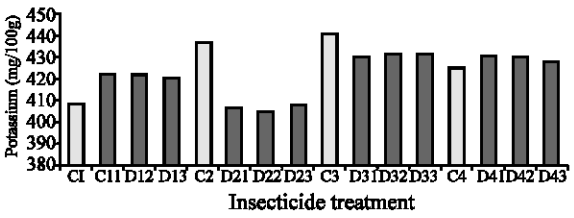


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Fig. 7: Effect of insecticide treament on potassium content of cottonseeds

organophosphorus insecticide malathion, at low concentration, has been shown to increase protein synthesis in plant, moreover, Habiba *et al.*,[] found that the pesticide profenofos application increase the total protein of potatoes.

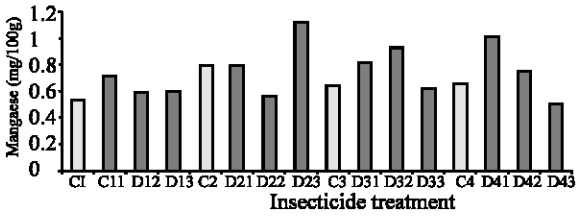


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Fig. 8: Effect of insecticide treament on manganese content of cottonseeds

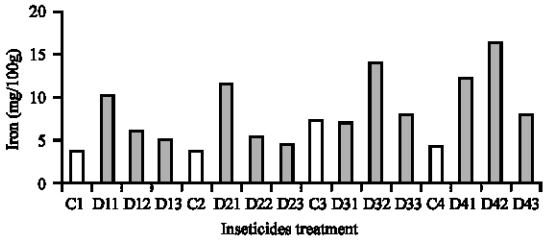


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Fig. 9: Effect of insecticide treament on iron content of cottonseeds

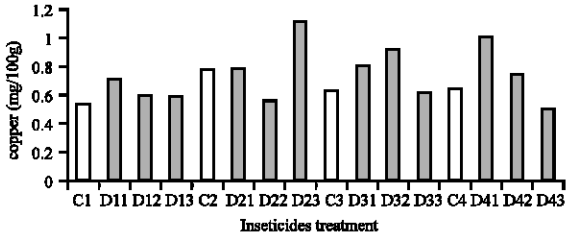


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Fig. 10: Effect of insecticide treament on copper content of cottonseeds

However, in all treatments protein content of Barac-67 was significantly higher than that of Barakat-90. In both seasons, and for both cultivars, only slight differences in protein were observed between different types of pesticides and among their different level of concentrations for the same cultivar. This finding confirmed what was reported by Penday and who stated that any increase in cottonseed protein will result in relative reduction in oil and vice versa.

Figure 5 and 6 illustrate the results of tannins content of cottonseeds for Barakat-90 and Barac-67 cultivars, as affected by chlorpyrifos, in the first and second season. It is apparent from these results that, tannins content of Barakat-90 and Barac-67 cultivars, in the first season, in all treatments was significantly lower than that of the control, except for the third level of Barac-67. This was similar to the observations of Yokoyama *et al*.,[16] who reported that methylparthion caused slight depression in tannin concentration of cotton plant.

In both seasons, tannins content of Barac-67 cultivar with all treatments was significantly higher than that of Barakat-90 cultivar. This may be attributed to varietal differences.

While for phytic acid as shown in Fig.7 and 8 both increase and reduction of phytic acid was observed compare to the control. Modgil *et al.*,[17] stated that the infestation of crop with insect had increased phytic acid. While Jood *et al*.,[3] reported that infestation of insect, caused reduction in phytic acid of maize,

The effect of different levels of chlorpyrifos on mineral content is shown in Fig. 9 and 10 in both seasons and for cultivars. It can be seen from these figures that significant reduction was observed in calcium, which was in harmony with what was reported by[18] who observed that calcium uptake decreased in cotton plant treated with chlordimeform insecticide. While for sodium, potassium, manganese, iron and copper no consistent pattern of change was observed. These variation may be closely related to the effect of insecticides on insect infestation .Modgil[19] reported that infestation of mung pea and pigeon pea with pulse beetle, increase iron content in its seeds.

## CONCLUSIONS

Significant changes in chemical constituents of cotton seeds is observed as a result of insecticide treatment, some changes have no consistent pattern.

## REFERENCES


1. Guantick, H.R., 1985. Aviation in Crop Protection Pollution and Insect Control. First Edn., Collans. London.
2. Singh, O.P., P.K. Verma and B.R. Singh, 1985. Physiological effect of synthetic pyrithroids on cotton. Pesticides, 19: 49-52.
3. Jood, S., A.C. Kapoor and R. Singh, 1995. Polyphenol and phytic acid contents of cereal grains as affected by insect infestation. J. Agric. Food Chem., 43: 435-438.
4. Sandhu, S.S., P. Chander, J. Singh and A.S. Sidhu, 1987. Effect of insecticidal sprays on the plant and secondary pest inductions in *Hirsutum* Cotton in Punjab. Agriculture, Ecosystems and Environment, 19: 169-176.
5. Mather, A., S. Mather and S.N. Mather, 1990. Effect of dimethoate growth yield and nitrogen content in *Vigena mung L.* Indian J. plant Physiol., 33: 97-100.
6. ARC., 1996. Technical packages for cotton crop. Agricultural Research Corporation Report. Agricultural Research Corporation, Sudan.
7. Hussein, S., 1987. Aqueous protein and gossypol extraction from glandless cotton flour. M.Sc. Thesis, Faculty of Agriculture, University of Khartoum.
8. AOAC, 1984. Official Method of Analysis of the Association of Official Analytical Chemists. 11th Ed. Association of Official Analytical Chemists. Washington, D.C.
9. Isaac, R.A. and W.C. Johnson, 1975. Collaborative study of dry and wet techniques for elemental analysis of plant tissues by the atomic absorption spectrophotometry J.AOAC, 58: 336 -340.
10. Price, M.L. and L.G. Butler, 1977. Rapid visual estimation and spectrophotometeric determination of tannin content of sorghum grain. J. Agric. Food Chem., 25: 1268–1273.
11. SAS, 1999. SAS User's Guide. Statistics. 1st Edn., SAS Institute Cary, N.C.
12. Epp, E.A., 1953. Effect of 2, 4-D on growth and yield of cotton. J. Agric. Food Chem. 1: 1009-1112.
13. Sivakumar, G.S. and A.V. Veeresh, 1987. Methylparathion modulates lipid biosyrothesis in songhum (*sorghum bicolor*) Moench. Pesticide Biochemistry and Physiology, 28: 341-348.
14. Palm, C.E., W.W. Dystra, G.R. Fargusson, R. Hansberry and G.R. Sawanson, 1968. Effect of pesticides on fruits and vegetables physiology. Principle of plant and animal pest control, volume 6. National Academy of Science. Washington D.C.
15. Chakraborti, S., S. Ghishlastidov, K.K. Das and S.K. Banerjee, 1980. Malathion exposed seeds of Vigna sinensis: Change at protein and nucleic acids level. Ind. J. Exp. Biol., 18: 885- 889.

16. Yokoyama, V.Y., B.E. Mackey and T.F. Leigh, 1987. Relation of cotton protein and tannin to methylparathion treatment of J. Econ. Entomol., 80: 834-839.
17. Modgil, R., U. Mehta and S.K. Singhal, 1993. Effect of oil treatments on the levels of factors in Callosobruchus chinensis (L.) infested stored pulses Nahrung., 37: 602-608.
18. Cathey, G.W. and J.C. Bailey, 1987. Evaluation of chlordimeform for cotton yield enhancement. J. Econ. Entomol., 80: 670-674.
19. Modgil, R., 2000. Mineral content of insect infested stored legumes treated with edible oils. Nahrung., 44: 415-422..