PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
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Pakistan Journal of Nutrition 5 (5): 441-444, 2006
ISSN 1680-5194

Persistence and Biochemical Signs of Malathion on Cottonseeds

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Abstract: Two Field experiments were carried out during the season 2000 / 2001 and 2001 / 2002 to investigate the persistence and effect of the insecticide Malathion, on cottonseed quality of two local cultivars, Barakat-90 and Barac-67. Three concentration levels of this insecticide were applied on field grown cotton. The insecticide residue was analyzed. Oil, protein, phytic acid and mineral contents of cottonseeds were determined. No malathion residues were detected in all samples of different levels of treatments. The results also 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, in the first season. Protein content increased significantly in cottonseeds of both cultivars. No significant change was noticed in phytic acid except for Barac-67 cultivar in first season. Moreover the change in minerals of the cotton seeds showed no consistent pattern as influenced by different treatments.

Key words: Malathion, cottonseed, oil, protein, phytic acid, minerals

Introduction

Malathion [S-(1,2-dicarboethoxyethyl)] O,O-dimethylphosphorodithioate) is an organophosphorus insecticides that provides excellent control of many insects (Muan and Skaare, 1986). Therefore, it is widely and successfully used in several major crops, including cotton crop (James *et al*., 1984). Occurrence of malathion and other insecticides residues in cottonseeds and its products, due to intentional uses of those insecticides for the control of cotton crop insects, have been reported and investigated by many workers (Sisken and Newell, 1972; Abdelgawad *et al*., 1973; FAO/WHO, 1978; Greenberg, 1987; Kumar and Regupathy, 1999). The amount of malathion residues generally vary with insects to be controlled, and the level and time of treatment relative to harvesting of the crop (Jones, 1996). Although very few studies have been reported about the influence of insecticides on quality attributes of cottonseeds, Malathion has been investigated for its potential to change chemical constituents of Cottonseeds (Chakraborti *et al*., 1980).

The objectives of this study were to evaluate the residual level of the insecticide malathion in cottonseeds as well as to study its effect on oil, protein, phytic acid and minerals content of cottonseeds of two local cultivars, Barakat-90 and Barac-67.

Materials and Methods

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

Field experiments: Two successive field experiments were carried out during the season 2000 / 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 (ARC, 1996). Experimental plots were arranged in a randomized complete block design with three replicates. The insecticide Malathion was applied at three concentrations, recommended dose, 1.5 and two folds the recommended dose. Samples from each plot were harvested manually.

Preparation of samples: 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 Hussein (1987). The seeds from each plot were milled, mixed properly and divided into two parts, one portion was stored in a freezer for determination of insecticide residue, while the other was kept on polyethylene bags for chemical analysis.

Insecticide residue analysis: Exactly one hundred grams of ground cottonseed samples from each treatment were mixed into a blender jar with 500 ml of chloroform at low speed, for 30 minutes. The mixture

Table 1: Residues levels detected in cottonseeds of Barakat-90 and Barac-67 cultivars treated with different levels of insecticide malathion

Insecticide treatment	Average of residue levels (mg/kg)	Range of residue levels (mg/kg)	Positive tested samples (%)	Violative samples (%)
Recommended dose (Barakat) first season	ND	ND	ND	0.0
1.5 fold dose (Barakat)) first season	ND	ND	ND	0.0
Double dose of (Barakat) first season	ND	ND	ND	0.0
Recommended dose (Barac)) first season	ND	ND	ND	0.0
1.5 fold dose (Barac) first season	ND	ND	ND	0.0
Double dose (Barac)) first season	ND	ND	ND	0.0
Recommended dose (Barakat) second season	ND	ND	ND	0.0
1.5 fold dose (Barakat) second season	ND	ND	ND	0.0
Double dose of (Barakat) second season	ND	ND	ND	0.0
Recommended dose (Barac) -second season	ND	ND	ND	0.0
1.5 fold dose (Barac) - second season	ND	ND	ND	0.0
Double dose (Barac) - second season	ND	ND	ND	0.0

Table 2: Effect of Malation Application on oil and protein content of cottonseeds of Barakat-90 and Barac-67 cultivars

Insecticide Treatments	First season		Second season	
	Oil %	Protein %	Oil %	Protein %
Control (Barakat)	27.59	12.20	27.82	15.87
Recommended dose (Barakat)	31.88	17.50	27.60	15.85
1.5 fold dose (Barakat)	31.83	18.44	28.44	18.27
Double dose of (Barakat)	32.82	15.91	27.33	19.28
Control (Barac)	22.92	16.50	23.8	20.81
Recommended dose (Barac)	22.80	22.50	21.64	21.37
1.5 fold dose (Barac)	24.07	22.41	19.9	19.1
Double dose (Barac)	21.77	21.58	21.38	20.35

Table 3: Effect of Malation Application on Phytic acid content of cottonseeds of Barakat-90 and Barac-67 cultivars

Insecticide Treatments	Phytic acid (mg/100 g)	
	First season	Second season
Control (Barakat)	1887.83	2852.72
Recommended dose (Barakat)	1924.34	2761.13
1.5 fold dose (Barakat)	1522.78	2503.07
Double dose of (Barakat)	1444.55	2831.72
Control (Barac)	2839.10	2839.56
Recommended dose (Barac)	3316.51	2761.34
1.5 fold dose (Barac)	2623.14	2454.35
Double dose (Barac)	2499.92	2033.85

was allowed to set for 10 minutes, and filtered through whatman filter paper No.2. The jar was washed with two aliquots of 100 ml of the extraction solvents, and added to the filter. Rotary evaporator was used to evaporate the combined filtrate extracts. Extracted samples were eluted through celite columns which were rinsed with 20 ml of hexane. Solvent was evaporated, and then residues were dissolved in 2 ml of acetone (Zweig, 1972). Detection of the insecticidr residue was carried out by using high performance liquid chromatography (HPLC) with universal column, and UV detection at 210 nm. The compounds were separated using gradient of 45-99% acetonitrile in water at a flow rate of 1.0 ml/min in a period of 15 min. (Abu-Qare and Abou-Donia, 2001)

Chemical analysis

Crude oil: Total crude protein of cotton seeds samples were estimated according to Official Methods of analysis (AOAC, 1984), Calcium, Magnesium, sodium, potassium, iron, and copper were estimated in mg/ 100 g by atomic absorption spectrophotometer (Perkin Elmer model 3110) according to the method described by Isaac and Johnson (1975). Phytic acid of cotton seeds samples was estimated according to the method described by Wheeler and Ferrel (1971).

Statistical analysis: Results were statistically analyzed using General Linear Model Procedure described by (SAS, 1999). Duncan's Multiple Range Test was used for means separation.

Results and Discussion

Table 1 gives the results of the residue levels in cottonseeds, harvested from the experimental plots, of the cultivars Barakat-90 and Barac-90, treated with the insecticide malathion at different level of concentrations. These results indicated that no detectable residues of the insecticide malathion were observed in all treatments of both cotton cultivars. These results are in harmony with those reported by (FAO/WHO, 1998) where no residues of malathion were observed in chestnut harvested from field treated with malathion, seven days after the last application. Moreover, after two days from the last application, malathion residues in cottonseeds were less than 0.05 mg/kg.

Table 2 shows the effect of different levels of treatments on the cottonseed oil and protein content of Barakat-90 and Barac-67 cultivar, in the first and second seasons The results indicated that, oil content of cottonseed of

Table 4: Effect of Malation Application on minerals content of cottonseeds of Barakat-90 and Barac-67 cultivars

InsecticideTreatments	First season				Second season			
	Cu	Fe	Mg	Ca	Cu	Fe	Mg	Ca
Control (Barakat)	1163.33	185.62	3.64	0.538	1408.1	198.75	7.33	0.634
Recommended dose (Barakat)	1120.17	177.5	4.52	0.526	1210.83	193.75	10.4	0.484
1.5 fold dose (Barakat)	1065.53	176.88	5.45	0.615	1140.83	195.83	10.74	0.54
Double dose of (Barakat)	1137.5	177.92	5.33	0.429	1286.33	196.67	12.33	0.51
Control (Barac)	963.33	196.92	3.64	0.773	875	190	4.34	0.648
Recommended dose (Barac)	413.33	185.58	4.53	0.528	605.67	196.25	7.94	0.435
1.5 fold dose (Barac)	419.17	185.67	5.46	0.539	683.33	192.08	7.45	0.49
Double dose (Barac)	436.5	182.48	3.54	0.661	619.17	190	6.81	0.546

Barakat-90 cultivars in both seasons, was significantly higher than the untreated (control). However, in the first season, no significant differences was observed, in Barac-67 cultivar. These findings are not in agreement with those reported by Kittock and Pinkas (1971), who reported that pesticides usually causes reduction in cottonseed oil content. 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. Protein content results of all treatments of both cultivars, in the first season, were significantly higher than that of the control, except for Barac-67 in the second season. These results agree with those of Chakraborti *et al.* (1980) who observed that the organophosphorus insecticide malathion, at low concentration, has been shown to increase protein synthesis in plant, moreover, Habiba *et al.* (1992) found that the pesticide profenofos application increased the total protein of potatoes.

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 Pandey and Thejappa (1978) who stated that any increase in cottonseed protein will result in relative reduction in oil content and vice versa.

Table 3 shows the results of phytic acid content of cottonseeds for Barakat-90 and Barac-67 cultivars, in the first and second season respectively. It is apparent from these results that, phytic acid content of Barakat-90 and Barac-67 cultivars, in the first season, in all treatments no significant change was noticed in phytic acid except for Barac-67 cultivar in first season.

Table 4 reveals the results of mineral content of cottonseeds for Barakat-90 and Barac-67 cultivars, in the first and second season These results indicated that change in minerals of the cotton seeds as affected by malathion treatment showed no consistent pattern.

In conclusion, No malathion residues were detected in all samples of different levels of treatments. However, significant changes were observed in chemical constituents of cotton seeds as affected by malathion treatments, but these changes have no consistent pattern.

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