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USE OF VEGETABLE OILS TO PROTECT BEANS FROM BRUCHID ATTACK

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An ancient method used in India to protect stored pulses from Bruchid attack was shown by Dr. S. R. Singh at IITA to protect stored cowpeas from Callosobruchus maculatus attack. Groundnut oil at 5-10 ml/kg, protected seed for up to six months. The thin oil layer is believed to limit the oxygen for the embryo, (Singh, pers. comm.; IITA, 1975),

At CIAT the method was tested for protection of stored dry beans (Phaseolus vulgaris L.) against the Bruchid Zabrotes subfasciatus (Boh.), a species with similar oviposition behavior to C. maculatus. Both species glue their eggs under a protective cover, to the seed coat.

Methods

Beans of the variety Diacol-Calima were treated with 0, 1 or 5 ml of different vegetable oils* (African palm, cottonseed, maize, soybean or coconut palm oil) prior to infestation with newly emerged adults reared on the same variety. The oils were mixed with the seed in a tumbler for 5 min at 35 rpm. Each treatment was made in 5 replicates, with 100 g of seeds per replicate to be infested with 7 pairs of adults. Progeny adults were recorded and removed every other day. The experiments were carried out under laboratory conditions. The samples were reinforced 75 days after the oil treatment. A new set of controls was used.

In a second experiment the influence of oil treatments on adult mortality, egg laying and progeny adult emergence was tested. Only crude cottonseed oil and African palm oil were used. Viable eggs were distinguished from non-viable ones when the former turned white, indicating larval penetration into the seed.

To test the influence of oils on developing larvae, seeds infested for 4 days with large amounts of adults were left 11 additional days, then were treated with crude cottonseed oil and sampled and infested as before.

All data were analyzed using a square root transformation and significance levels are given for $p<0.05$, indicated by different letters following the data in the tables.

Results

Addition of 1 ml of oil to bean seeds significantly reduced progeny adult emergence (Table 1). The progeny production differed significantly among the oils tested. The reduction was least for purified soybean oil,

* Oils were obtained in local Colombian markets.

and highest for African palm oil, with 38.2 and 4.2 progeny Bruchids observed, respectively. At 5ml of oil, no progeny emerged from beans treated with maize oil. African palm oil, and crude cottonseed oil, while a maximum of 3 adults emerged from beans treated with purified coconut oil. Progeny emergence was reduced significantly more by crude oils compared with the purified oils, and 5 ml oil treatments provided significantly better protection than 1 ml oil, measured in progeny emerged.

When infested 75 days after treatment, progeny production increased significantly compared with the immediate (0 day) infestation, however, the two controls did not differ significantly. Again the type and purity of the oils and their dosage gave significantly different results. Only African palm and cottonseed oil provided sufficient protection. While the other oils at 1 ml reduced progeny emergence significantly compared with the control, their approximate 75% reduction is not enough for consumer needs. At 5 ml African palm oil and crude cottonseed oil gave nearly complete control.

The effect of oils on Bruchids is multiple (Table 2). Adults placed on oil treated beans lived for shorter times than did those on non-treated beans. Total egg production and numbers of viable eggs, non-viable eggs and progeny adults were all reduced significantly.

It appeared that 5 ml of cottonseed oil applied when larvae have penetrated the seed still affects adult emergence (Table 3). Progeny emergence was significantly reduced compared with the control. The significantly higher emergence of Bruchids from beans treated in the tumbler without oil cannot be explained.

Conclusion

Vegetable oils, especially African palm and cottonseed oils, provide high levels of Z. subfasciatus control when applied to beans prior to infestation. These treatments are non-toxic, and easy for the consumer or small farmer to carry out as well as being cheap. Under current price conditions (Oil, Col. pesos 40/liter and beans Col. pesos 38/kg), the 5 ml application cost is Col. pesos 0.20, about 0.5% of the market price of beans.

The physical appearance of beans is often improved as they are shinier after treatment and appear to be newly harvested. Research is continuing on possible effects on seed germination and cooking quality.

Reference:

IITA, 1975. Intern. Inst. of Tropical Agric. Ann. Report 1975, p. 101.

Table 1. Z. subfasciatus reproduction on beans treated with vegetable oils. (Avg. 5 replicates of 100 g beans each, infested with 7 pairs adults).

Oil	ml/kg seed	No. of progeny adults emerged after infestion at days after treatment 0	75
African palm	1	4.2	6.4
	5	0	0
Cottonseed (crude)	1	5.2	5.2
	5	0.	0.2
Cottonseed (purified)	1	6.4	70.4
	5	0.2	34.4
Maize	1	21.4	91.0
	5	0	18.2
Soybean (crude)	1	28.0	66.0
	5	2.4	30.0
Soybean (purified)	1	38.2	78.4
	5	1.0	29.0
Cocconut palm (crude)	1	13.8	61.4
	5	0.2	20.4
Cocconut palm (purified)	1	27.4	65.8
	5	3.0	26.0
Control	0	264.8	251.0

Table 2. Influence of 2 vegetable oils on Z. subfaciatus adult mortality, oviposition and progeny emergence. (Avg. 5 replicates of 100 g beans each, infested with 7 pairs adults).

Oil	ml oil/ kg beans	% adult mortality at 2 d*	% adult mortality at 9 d*	No. of hatched eggs	No. of non-viable eggs	No. of progeny adults emerged	% of viable eggs resulting in emerged adults
Cottonseed (crude)	1	33.3	100	14.8b**	11.2b	2.6b	17.6
	5	100	100	1.0c	1.8c	0 c	0
African palm	1	39.7	100	3.8c	10.2b	0 c	0
	5	100	100	0 c	0 c	0 c	0
Control		0	20.3	186.4a	47.6a	137.6a	73.8

* days
** Means followed by different letters within the same columns are significantly different at P 0.05.

Table 3. Influence of crude cottonseed oil on developing larvae of Z. subfasciatus. (Seed infested for 4 days, then left for 11 days before oil treatment. Avg. 5 replicates of 100 g beans each, infested with 7 pairs adults.)

Treatment	Avg. No. of progeny adults per replicate
Cottonseed oil (1 ml)	549.0 b *
Cottonseed oil (5 ml)	387.0 c
Tumbler (no oil)	951.2 a
Control	649.8 b

* Means followed by different letters are significantly different at P 0.05.