SELECTION OF NEW INSECTICIDES FOR USE IN MAIZE STORAGE AT THE FARMER's LEVEL IN NIGERIA

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INTRODUCTION: Maize is a very important crop in Nigeria. It is utilised mainly for human consumption and forms about 50-70 per cent of the constituents of livestock feed. Nigeria produced 1 million tons of maize in 1975.(1), and an appreciable quantity is imported annually to supplement the local production.

About 90% of the maize produced is stored by farmers in their farms or villages in traditional storage structures. It was reported by Adesuyi and Shode (2) that 24.7% of maize stored by the traditional method was lost to storage pests and viability of grains reduced from 97.7% to 28.3% for NSI variety and from 95.8% to 31.6% for FAS 26 variety after 6 months' storage; it was therefore thought essential that maize storage at the farmer's level should be given priority so as to reduce the substantial losses occurring in the farms. Methods of improving the traditional structures and introducing pest control measures suitable for such structures needed to be evolved as the farmers lost confidence in sophisticated methods of storage some years back due to the failure of the silo scheme introduced in the former western parts of Nigeria.

The previous recommendation of insecticides for use in traditional structures was Gamma BHC at 12.5 ppm of cob weight (3). Maize so treated was not to be consumed until after 3 months because of high toxicity. The fact that insect resistance to Gamma BHC has been reported (4) and farmers can sell their treated maize before the recommended 3 months, have made it necessary to investigate new insecticides of low mammalian toxicity with a view to replacing Gamma BHC.

Three insecticides were investigated over a period of 3 years. They are

(1) Iodofenphos, (O.O. - dimethy (-O(2-5 dichloro 4 iodophenyl) thiophosphate with an LD 50 of 2,100 mg/kg for rats and acute dermal LD 50 of 2000 mg/kg.

(2) Pirimiphos-methyl, (2-Diethylamino - 6 methyl pyrimidine)-4-1 dimethyl phosphorothionate with an LD 50 of 2,050 mg/kg for female rats and acute dermal LD 50 of more than 2,000 mg/kg for rabbits.

(3) Tetrachlorvinphos, the Cis isomer (Chloro - and phosphate groups adjacent) of 2-chloro-1-(2-4, 5-trichlorophenyl) vinyl dimethyl phosphate, with an LD 50 within the range 4,000 to 5,000 mg/kg for rats, and 2,000 mg/kg for rabbits and dogs.

MATERIALS AND METHODS: The variety of maize used for these trials was the Western Yellow I, which had been developed and released to farmers. The trials were carried out at the Nigerian Stored Products Research Institute (N.S.P.R.I.) Ibadan. The storage structure used was the improved crib which is the village-level storage structure N.S.P.R.I. has introduced to the farmers in the past 10 or more years. Four cribs, each 1.5 meters wide, 1.5 meters long, and 1.2 meters filling height were constructed for each treatment. Half a ton of the maize variety was loaded into each crib. Three doses of 5, 10, and 15 parts per million (ppm) of the dust formulations of Iodofenphos, 5 percent active ingredient, Pirimiphos-methyl, 2 percent active ingredient and Tetrachlorvinphos 5 percent active ingredient were tried. Each dose with control was tried in four replicates. The cribs were allocated to each treatment and doses at random. The sheath on the maize cobs was removed and the required quantity of insecticide was applied layer by layer on the cobs as the cribs were being loaded. A cigarette tin with holes on the lid was used to apply the insecticide dust.

The assessment of initial moisture content and percentage insect damage was done with ten cobs taken at random from each crib. A ventilated oven was used to determine the moisture content of the maize sample in three replicates of 15 gm each by heating for 4-1/2 hours at 104°C. The shelled maize was divided into subsamples by the method of coning and quartering. The insect damage count was carried out on 500 grains chosen at random from the subsample. Similar samples, for the determination of moisture content and assessment of insect damage, were taken monthly for the 10 months of storage trial.

RESULTS AND DISCUSSION: The mean monthly moisture content of each treatment is shown in Table 1. There was a general rapid rate of drying from September and the moisture content was below the safe moisture content for storage of maize (13.5%) from November until February. It increased from March and by May it was generally above the safe level for storage in silos but remained under 15% and therefore still safe enough for storage in sacks. The increase in moisture content was due to rainfall and high humidity from March.

Table 2 shows the mean monthly insect damage for all the treatments. The trend with the three insecticides was very

Table I. Mean monthly moisture content

Month	Iodofenphos (ppm)				Pirimiphos-methyl (ppm)				Tetrachlorvinphos (ppm)			
	Control	5	10	15	Control	5	10	15	Control	5	10	15
August	27.5	26.6	26.7	27.0	27.2	26.0	26.6	25.9	26.6	26.8	25.9	26.2
September	19.5	19.2	18.9	19.0	18.9	18.5	18.0	18.1	19.8	18.5	18.2	19.8
October	15.2	15.1	15.2	16.2	16.1	15.6	15.5	16.4	16.2	16.4	15.9	15.4
November	11.5	11.9	12.0	12.2	11.6	12.1	12.4	12.6	12.5	12.4	12.6	12.5
December	10.6	10.5	10.9	11.0	10.9	10.2	11.5	11.2	11.6	11.6	11.5	11.7
January	6.9	7.2	7.4	7.9	6.8	7.5	7.4	8.2	11.2	11.2	11.2	11.2
February	10.5	10.1	10.7	10.6	10.7	9.9	10.5	10.4	10.4	10.6	10.6	10.8
March	14.5	13.2	13.1	13.0	14.2	13.2	13.0	12.7	13.4	13.5	12.6	13.0
April	14.6	13.4	12.5	12.6	14.4	13.4	12.9	12.8	14.2	13.7	13.2	13.2
May	14.8	13.6	14.1	13.9	14.5	13.6	14.2	13.5	14.4	13.9	13.8	13.7
June	14.8	13.0	12.2	13.2	14.5	13.2	13.0	13.2	11.9	14.2	14.0	14.2

Table 2. Mean monthly percentage insect damage (averages of four cribs per treatment)

Month	Iodofenphos (ppm)				Pirimiphos-methyl (ppm)				Tetrachlorvinphos (ppm)			
	Control	5	10	15	Control	5	10	15	Control	5	10	15
August	0.4	0.2	0.8	0.5	1.4	1.1	1.2	1.0	0.6	0.4	0.6	0.5
September	4.2	2.8	3.4	3.4	3.7	3.4	2.9	0.0	4.2	0.0	0.5	1.6
October	11.5	8.4	3.8	3.6	11.4	4.5	4.5	0.0	12.5	8.2	5.4	2.5
November	16.4	14.0	5.0	6.2	14.8	11.8	5.2	0.0	15.2	11.6	8.6	2.4
December	20.0	14.5	5.6	7.4	17.6	23.5	7.2	0.4	20.8	13.4	9.5	2.6
January	25.4	15.9	6.8	9.2	20.5	25.0	7.4	3.2	23.6	14.5	9.6	3.0
February	28.5	22.4	5.4	9.8	22.6	27.5	8.4	7.6	25.4	16.4	9.8	3.8
March	30.0	24.5	6.9	10.0	26.1	28.4	9.5	7.0	27.8	18.2	9.4	4.2
April	36.6	26.2	12.2	9.2	29.3	31.2	11.4	3.5	40.5	20.2	9.8	5.5
May	66.4	30.4	45.6	12.6	53.4	36.4	26.5	19.9	55.7	27.5	27.1	10.0
June	75.9	56.8	50.8	16.5	79.5	51.6	49.8	42.5	78.6	48.4	48.8	19.5

similar for each of the doses applied. If an acceptable level of 10% damage is assumed, it can be seen from the results that at 5 ppm the three insecticides were effective for only 2 months, at 10 ppm Iodofenphos and Pirimiphos-methyl were effective for 7 months, Tetrachlorvinphos for 8 months, and at 15 ppm Iodofenphos and Pirimiphos-methyl were effective for 8 months, while Tetrachlorvinphos was effective for 9 months.

The results of these trials show that any of these insecticides applied at 10 ppm can be used by the Nigerian farmers to treat their maize stored in cribs instead of gamma BHC, as they do not generally store for longer than 8 months in such a structure.

In an ideal situation, the three insecticides should not be recommended for use simultaneously because of the problem of insects being resistant against all of them at the same time. In Nigeria, as with many other developing countries, other considerations override the above principle.

Such considerations are:

(1) Comparative effectiveness of the insecticides. The three insecticides tested have satisfied the requirement of being effective in controlling insects on stored maize for a minimum of 7 months.

(2) Toxicity: The three insecticides are much safer than gamma BHC with acute oral LD 50 of 125 mg/kg for rats and dermal LD 50 of 500 mg/kg when compared with their LD 50 quoted earlier.

(3) Percentage active ingredient: It is required that the insecticides to be introduced to the Nigerian farmer should be of very low active ingredient. This has the advantage that large quantities of the dust will have to be applied and better coverage of the produce treated will be achieved.

(4) Cost: The insecticide should be cheap.

(5) Availability: This is by far the most important factor. The insecticide recommended should be readily available, especially during the storage season. Our experience has been that there is acute shortage of recommended pesticide at the time it is most required. This has a damping effect on the farmers, who have taken to these recommendations and seen the beneficial effects. As a result of this, it has not been possible to restrict our recommendation to one insecticide at a time. It has been observed that recommending more than one insecticide at a time results in the sales agents complementing one another rather than competing.

(6) Packaging: Most of the farmers that use insecticides for storage require small quantities. It is therefore desirable that insecticide manufacturers pack them in such small quantities that it is practicable for the farmer to handle and exhaust in one operation. This will reduce the dangers of careless handling, poisoning, wastage, and underdosing or overdosing.

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