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Efficacy of Apron Star in the Control of Pests of Maize in the Northern Guinea Savanna of Nigeria

CHRISTOPHER I. AMATOBI
Department of Crop Protection,
Institute for Agricultural Research,Ahmadu Bello University,
Zaria, Nigeria.

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ABSTRACT

Apron Star (trimethioxam 20% metalaxyl 34%, difenonazole 2%) (AS) at various rates was evaluated along with Apron Plus (metalaxyl 10%, carboxin 6.0%, furathiocarb 34%), a conventional seed dressing chemical. Major seedling pests observed were the bird species: *Columba guinea, Streptopelia decipiens* and *S. senegalensis* and a millipede, *Peridontopyge spinosissima*. The two chemicals were lethal to millipedes and were antifeedant to birds. Treated seeds had significantly ($P < 0.05$) greater seedling emergence, more vigorous plant growth, higher numbers of harvestable maize cobs and higher grain yields than the untreated control. Apron Star at 3.5g a.i/kg maize seed was found to be as effective as Apron Plus (AP) at 10g a.i/kg maize seed with respect to pest control level and other parameters.

INTRODUCTION

In West Africa, maize is one of the cheapest source of carbohydrate for human and livestock consumption and for industrial use. (Amatobi, 1986 and Fakorede *et al.*, 1989). Major maize growing areas during the rainy season in Nigeria include the Derived Savanna, the Southern and Northern Guinea Savanna (Fakorede, 1989) and a very limited area in the Sudan Savanna (Amatobi 1986). A small quantity of maize is also produced under irrigation as green maize.

One of the major constraints in maize production is the attack of planted maize seeds and seedlings by soil insect pests: *Buphonella* sp. (Maize Rootworm), *Gonocephalum* sp. (Ground Beetle). *Heteronynchus licas* Klug (Black Maize Beetle),

Odontotermes sp., *Microtermes* spp. and *Ancistrotermes* sp (Termites) (NRI, 1996) as well as some fungal diseases.

Various insecticide dusts have been employed to prevent seed damage, including diazinon, endosulfan, monocrotophos, H.C.H (Hexa chlorohexane), carbofuran (Furadan). Apron Plus (NRC 1996) and aldicarb (Chidiu *et al.*, 1995). Recently, a new chemical Apron Star has been developed by NORVATIS Services AG (Ciba Giegy).

Any newly formulated pesticide has to be evaluated by a National Institution before being recommended for use. In 1999, NORVATIS Services AG sent samples of a new product, Apron Star to the Institute for Agricultural Research (IAR), Ahmadu Bello University, Zaria for evaluation, which is reported here together with Apron Plus.

MATERIALS AND METHODS

Land Preparation and Sowing of Seeds

The experiment was conducted in the Institute for Agricultural Research (IAR) farm at Samaru, Zaria (Lat. 11° 11' N, Long. 7° 38' E and Altitude 686m) in the Northern Guinea Savanna of Nigeria during 1999 and 2000. The vegetation is dominantly grass and the annual mean rainfall for the period was about 1200mm and fall from July to late September. Maize is usually planted in June or July.

The fields used for the experiments were previously cropped to cowpea. An area measuring about 0.1 ha was harrowed and ridged at 75cm spacing. Twenty plots each 6m x 4.5m (= 6 ridges) were market out and separated by buffer zone 75cm wide.

There were five levels of pesticide treatments Apron Star (20% thiamethoxam, 20% metalaxyl-M, 2% difenoconazole) at 1.5 g, 2.5 g and 3.5g a.i/kg maize seed, a conventional seed dressing pesticide, Apron Plus (10% metalaxyl, 6% carboxin 34% furathiocarb) at 10g a.i/kg maize seed and zero pesticide as an untreated control. The trials were laid out in a randomized complete block design of four replications. A maize variety TZB SR was used. One kilogram of the maize grain was weighed for each treatment in a separate container and thoroughly mixed with the pesticide.

The grains were planted at 30cm intra-row spacing at a rate of two seeds per planting hill on July 2 and 17 respectively in 1999 and 2000. No other insecticide was applied. The fields were weeded three times at three weeks interval beginning from three weeks after planting with a hand hoe. Fertilizers, (NPK (20:10:10) and Urea) were spot applied respectively 2 weeks after planting and at tasselling stage.

Pest Damage Assessment

Four inner rows of plants were selected for data collection. Observation was taken on birds such as *(Calumba guinea* Linnaeus HBF *Streptopelia decipiens* and *S. senegalensis* Linnaeus which pulled out the seedlings. and ate some seeds. At 10 days after planting (DAP) therefore the number of seedlings pulled out in each plot was recorded. Dead arthropods such a millipedes found on the surface of the soil were counted and recorded. The planting hills without seedling were counted so as to determine the percentage planting hills without seedlings. The soil around the planting hills without seedlings was examined for any pests suspected to attack the maize seeds and emerging seedlings. At 3 WAP the maize seedlings that wilted were dug out and some of the seedlings were also found to be attacked by millipedes. The living and dead millipedes were counted and recorded.

The plant vigour was scored at 4 WAP using the score range of 1 - 5, where 1 = very poor vegetative growth, 2 = poor vegetative growth, 3 = fairly good vegetative growth, 4 = good vegetative growth and 5 = luxuriant vegetative growth.

On November 30 and December 7 respectively in 1999 and 2000 (i.e. 19 WAP),ten plants were selected randomly in the sample rows of each plot. The stems were cut from the base, then split open to determine the percentage of stems attacked by stem borers. The samples of the millipedes collected were sent for identification at the Institute for Agricultural Research, Samaru, Zaria.

Yield Assessment

At harvest, December 5 and 12 respectively in 1999 and 2000 the plants in the four inner rows were counted to determine the percentage survival. The plants were then cut, all the ears harvested and separated into harvestable cobs i.e. cobs with grains and non-harvestable cobs i.e. cobs with no grains. The cobs were dried, threshed and the grains weighed.

Statistical Analysis

The data collected for each parameter were averaged over all the replications to obtain a plot mean for each year. The data were subjected to analysis of variance.

RESULTS

Pest Damage

Seedling emergence and the percentage loss of seedlings observed at 3 WAP were lowest in the plots without seed treatment pesticides.(Table 1). In 1999, the seedling emergence in untreated plots was significantly different ($P < 0.05$) from the value for

Apron Star (AS) at 3.5g/kg seed. In 2000, however, it was significantly different from all treatments except in the AS 3.5g plot. The millipede *(Peridontopyge spinosissima* Solvestri *)* was found to be a major pest of planted seeds and seedlings of maize. Table 2 shows that in 1999, significantly more dead millipedes were found in plots treated with AS at 3.5g and Apron plus (AP) at 10g/kg seed than in plot with no pesticide treatment. In 2000 the control (no chemical treatment) plot value was only significantly different from the value for AP at 10g/kg seed.

In each year the millipede number found in the planting holes of the control plot (Table 2) was significantly different from the rest of the treatment values. In each year, the millipede numbers for the plots treated with AS 3.5g/ kg seed and AP 10g/ kg seed did not differ from each other but differed from the values for AS 1.5g/kg seed.

Table 1: Effect of seed dressings on (Apron star and Apron plus) maize seedling emergence at two weeks after planting in Samaru during 1999 and 2000 rainy seasons.

Treatment (g/kg seed)	1999		2000	
	Mean number of hills with seedlings	% loss of hills	Mean number of hills with seedlings	% loss of hills
*AS 3.5	75.25	11.4	70.75	15.8
AS 2.5	73.75	12.3	72.75	13.4
AS 1.5	72.0	14.3	73.25	12.8
AP 10.0	73.25	12.8	72.75	19.0
Control (no seed dressing)	67.0	20.4	68.0	19.0
LSD(P=0.05	6.50		4.38	

AS = Apron Star, AP = Apron Plus.

Table 2. **Effect of seed dressing on (Apron star and Apron plus) population of millipedes at Samaru.**

Treatments (g/kg seed)	Mean no of dead millipedes/plot		Mean no. of millipedes found on hills with no seedlings	
	1999	2000	1999	2000
AS 3.5	3.5	1.75	7.75	4.5
AS 2.5	2.75	1.10	8.75	6.75
AS 1.5	2.0	1.10	11.25	9.75
AP 10.0	3.5	2.25	7.0	3.75
Control (no seed dressing)	1.0	1.0	16.25	15.75
LSD(P = 0.05	1.42	1.10	3.24	2.60

AS = Apron Star, AP = Apron Plus

It was observed that some maize seedlings attacked by millipedes wilted. Table 3 showed that the plots of AS at 3.5g/ kg and AP at 10g/kg seed had no wilting seedlings at two weeks after planting and the values transformed showed that the values for AS at 3.5g/kg seed and AP at 10g/kg seed differed significantly from the rest of the values. The untreated control had the highest value followed by AS 1.5g/kg seed.

For the bird damage in 2000 (Table 4) the untreated control had significantly ($P < 0.05$) greater number of seedlings destroyed by birds than the plots treated with chemicals. Bird damage was not taken in 1999. The values for the chemically treated plots did not differ significantly ($P > 0.05$) from one another. The vegetative score at 7 weeks in 2000 (Table 4) showed that the plants in AS at 2.5g/kg had the most vigorous growth while the untreated control had significantly ($P < 0.05$) the lowest score. There was very low incidence of stem borers in 1999. In 2000, greater occurrence was observed but the values did not differ significantly ($P > 0.05$) from one another (Table 4).

The number of surviving plants at harvest showed that the untreated control had the lowest number (Table 5), which differed significantly ($P < 0.05$) from the rest values in 1999 but did not differ from one another in 2000. The percentage reduction in plant stand was greatest in the untreated control (Table 5).

Table 3. Mean numbers of millipedes found associated with wilting maize seedling treated with seed dressings at Samaru.

Treatments (g/kg seed)	1999		2000	
		Transformed		Transformed
AS 3.5	0.0	0.7	0.0	0.7
AS 2.5	1.0	1.18	1.5	1.36
AS 1.5	2.75	1.79	2.0	1.56
AP 10.0	0.0	0.7	0.0	0.7
Control (no seed dressing)	3.5	1.98	2.75	1.88
LSD (P = 0.05)		0.38		0.39

AS = Apron Star, AP = Apron Plus

Table 4: Effect of seed dressings on (Apron star and Apron plus) bird damage, stem borer incidence and plant vigour at Samaru during 2000 rainy season.

Treatment (g/kg seed)	Mean no. of maize seedlings attacked by birds	% of plants attacked by stem borers	Vegetative vigour score
AS 3.5	2.5	15	3.5
AS 2.5	2.75	17.5	4.5
AS 1.5	3.25	12.5	3.5
AP 10.0	1.75	15.0	3.75
Control (No seed dressing)	3.25	12.5	2.0
LSD (P=0.05)	2.11	NS	0.95

AS = Apron Star, AP = Apron Plus, Vigour score 5 = very good vegetative growth
2 = poor vegetative growth, 3 = fairly good vegetative growth
4 = good vegetative growth, 5 = luxuriant vegetative growth.

Table 5: Effect of seed dressings on (Apron star and Apron plus) the number of plant at harvest at Samaru.

Treatments (g/kg seed)	1999		2000	
	Mean No. of plant stands	% reduction of stands	Mean No. of plant stands	% reduction of stands
AS 3.5	64.25	23.21	66.75	20.54
AS 2.5	62.75	25.30	72.5	13.69
AS 1.5	59.75	28.87	76.0	9.52
AP 10.0	65.25	22.32	74.25	11.61
Control (no seed dressing)	83.5	35.31	84.25	23.51
LSD (p=0.05)	8.35		12.68	

AS = Apron Star, AP= Apron Plus.

More cobs were harvested per plot in 1999 than in 2000 (Table 6). There were significant differences between the number of cobs harvest in 1999. The number of unharvestable cobs was lowest in plots treated with AS at 3.5g/kg seed and AP at 10g/kg seed and the values were significantly lower ($P < 0.05$) than the value for control in 1999. In 1999, the number of harvestable cobs was significantly lower in control plot than in AS at 3.5g/kg seed and AP at 10g/kg seed. In 1999 the highest grain yield (2060.8kg/ha) was obtained from AS 3.5g plots but the value was not significantly different ($P > 0.05$) from that of Ap at 10g/ kg seed but was significantly higher ($P < 0.05$) than the rest values (Table 7). The value for the untreated control was significantly lower ($P < 0.05$) than the other of the values.

In 2000, the control had the lowest value (1043.4kg/ha) (Table 7), which was not significantly different ($P > 0.05$) from the values for AS at 2.5g/ kg seed and AS at 1.5g/ kg seed, but was significantly lower ($P < 0.05$) than the values for AS at 3.5g/kg seed and AP at 10g/ kg seed. The highest value for grain yield was obtained from the plot treated with AP at 10g/ kg seed.

Table 6: Effect of seed dressings on (Apron star and Apron plus) maize cob production at Samaru.

Treatments (g/kg seed)	1999		2000	
	HC	NC	HC	NC
AS 3.5	56.25	21.0	43.75	23.0
AS 2.5	51.25	25.25	39.5	30.75
AS 1.5	51.75	35.75	35.0	38.5
AP 10.0	61.75	22.25	43.5	30.75
Control (no seed dressing)	47.75	43.25	27.25	37.25
LSD (P=0.05)	22.76	16.4	13.03	15.68

AS = Apron Star, Ap = Apron Plus
HC = number of harvestable cobs: NC = Number of Non-harvestable cobs.

Table 7: Effect of seed dressings on (Apron star and Apron plus) maize grain yield at Samaru.

Treatments (g/kg seeds)	Mean grain Yields (kg/ha)	
	1999	2000
AS 3.5	2040.4	1826.7
AS 2.5	1605.0	1566.7
AS 1.5	1277.8	1546.7
AP 10.0	1980.7	2204.5
Control (No. seed dressings)	861.1	10403.4
LSD (P = 0.05)	294.5	690.0

AS = Apron Star, AP= Apron Plus.

DISCUSSION

The poor performance of untreated seeds was clearly expressed in the lower seedling emergence, lower plant stands, low cob setting, greater attack by pests, the high level of pest population and damage as well as lower yields than in the chemically treated plots. Raheja (1975) reported that millipedes were a major pest on groundnut in Nigeria. Similarly, millipedes have been reported as pests of cassava cutting (Akinbsotu *et al.*, 1987). It is also likely that fungal diseases may have contributed to poor seedling emergence although it was not investigated.

Three bird species, *C. guinea, S. decipiens* and *S. senegalensis* were identified as bird pests of maize in Samaru. They pulled up the seedlings of maize and fed on the seeds. It was observed that the seedlings of the treated seeds were pulled out but were not eaten indicating that the two chemicals were antifeedant to birds. The chemicals were lethal to millipedes and are additions to the list of chemicals toxic to millipedes. Since no other pesticide was applied the differences between the treated and untreated seeds upto harvest indicate that protection of seeds has a profound effect on the performance of plants in later stages.

The fact that no definite trend was obtained in the number of stem borers indicates that both chemicals have little or no effect on stem borer infestation in the later stages of the plant. It is not surprising that chemical spray was empisced for stem borer control (Uvah and Ajayi, 1993). The low yields obtained from the untreated plots for the two years two affirms the importance

The low yields obtained from the untreated plots for the two years affirms the importance of pesticide seed dressing in maize production.

Millipedes are reported as pests of maize for the first time in the Northern Guinea Savanna. Raheja (1975) similarly recorded millipedes as a major pest of groundnut in Nigeria. The importance of millipede as a pest of maize may increase with more areas coming under maize cultivation and more use of herbicides to destroy weeds, which form alternative host plants of millipedes when incorporated fresh into the soil. Apron Star at 1.5g/kg seed and 2.5g were not as effective as AS 3.5g or AP at 10g/seed.

Apron Star at 3.5g/kg seed was found comparable to Apron Plus at 10g /kg of seed and is a suitable alternative.

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