NIGER AGRIC. J. 35 (2004) 76 -85

EFFECT OF COMBINATION OF SOME PLANT POWDERS ON THE CONTROL OF *SITOPHILUS ZEAMAIS* MOTSCH

E. F. Asawalam and U. E. Arukwe
Department of Crop Protection
Michael Okpara University of Agriculture, Umudike
PMB 7267, Umuahia, Abia State
asawaldo@yahoo.com

ABSTRACT

Studies on the relative efficacies of mixtures containing different proportions of *Piper guineense* and *Nicotiana tabacum* and also different proportions of *Vernonia amygdalina* and *Ocimum grattissimum* powders against *Sitophilus zeamais* Motsch was carried out in the laboratory. The experiment was laid out in completely randomized design (CRD) with four replications. The result obtained indicated that *Piper guineense* combination with *N. tabacum* effectively protected the maize grain against weevil attack, though this efficacy reduced with reduction in *P. guineense* proportion in combination. The ranking effectiveness of powder mixture of *P. guineense* and *N. tabacum* in control of *S. zeamais* was $P_{100} + N_0 > P_{80} + N_{20} > P_{60} + N_{40} > P_{50} + N_{50} > P_{40} + N_{60} > P_{20} + N_{80} > P_0 + N_{100} > P_0 + N_0$. Generally, $P_{100} + N_0$, $P_{80} + N_{20}$ and $P_{60} + N_{40}$ were significantly superior ($P<0.05$) in their efficacy when compared with other treatments. $P_0 + N_{100}$ and the control ($P_0 + N_0$) were the least effective in terms of insect mortality but $P_0 + N_{100}$ recorded reduced mean number in adult emergence, reduced mean percentage loss in weight and damage caused by *S.zeamais* when compared with the other treatments. The mixture of *V.amygdalina* and *O. grattissimum* leaf powder showed minimal insecticidal property during the period of the study. *P.guineense* and *N. tabacum* mixture have potentials as positive seed protectants against *S. zeamais* (Motsch) at 42 days after treatments.

INTRODUCTION

Maize (*Zea mays* Linn.) is an important cereal crop in the world and ranks second, following wheat in the world's cereal crops production. It accounts for about 11.2% of grain produced in Nigeria (Lajide *et al.*, 1998; Emeasor *et al.*, 2002). By this, it forms a major part of the cereal crops consumed by man and serves as a source of dietary carbohydrate (Asawalam and Adesiyan, 2001).

Storage of maize is constrained by the menace of maize weevil (*Sitophilus zeamais Motsch)* (Emeasor *et al.*, 2002; Adedire and Ajayi, 1996). Profitable production of maize is seriously being hampered by the inability to store the grains for a long period without loosing a sizeable proportion to *S. zeamais* (Motsch). The menace of this insect on maize not only reduce the weight of the grains but also contaminate the grains with their fragments, faeces, webbing and metabolic products (Asawalam and

Adesiyan, 2001) causing loss of viability and nutrients and consequently lowering the quality and price of produce (Appert, 1987).

Dramatic success have been recorded in the use of synthetic insecticides such as hexachloro benzene (HCH), fenithion, malathion, chloropyritus, primiphos-methyl, tetrachlorides etc by farmers to protect grains (Lajide *et al.*, 1998) but it has a lot of short-comings ranging from high mammalian toxicity, high level of persistence in the environment, pest resistance, unsafe to workers, and expensive for resource poor farmers.

Prospecting for insecticidal plant products is being intensified worldwide in recent years as a cost effective and environmentally sustainable alternative for storage of grains (Ogunwolu and Odunlami, 1996, Lale, 1994 ,Shenge et al ., 2002, Jambere *et al.*,1995, Niber, 1994, Ofuya and Lale, 2001, Ofuya and Salami, 2002).

However, not much study has been carried out on efficacy of plant powder mixtures for insect control.This study therefore evaluated the efficacy of mixtures of powdered *Piper guineense* and *Nicotiana tabacum* as well as mixtures of *Vernonia amygdalina* and *Ocimum grattissimum* as maize protectants.

MATERIALS AND METHODS

INSECT CULTURE

Sitophilus zeamais Motsch. was cultured in the laboratory, by placing maize grains bought locally from the Umuahia main market in a bucket covered with muslin cloth, at ambient temperature of 20°C and relative humidity 60-70 percent. The cloth was held tightly in place by rubber bands to prevent the insects from escaping.

From this laboratory culture, freshly emerged adults of *S. zeamais* were taken for the study

COLLECTION OF UNINFESTED MAIZE GRAIN AND PLANT MATERIALS

Clean uninfested maize grains (Bende white) were purchased from a local farmer at Uzuakoli. Leaves and seeds of 4 (four) plant materials screened for insecticidal activity against *S. zeamais* were collected from Umudike, Umuariaga and Umuahia main market.

The list of the plant materials and parts used are given in Table 1.

PREPARATION AND APPLICATION OF PLANT MATERIALS

The plant materials were sun-dried until they were crispy dry and milled with a milling machine. The ground plant material was passed through a mesh size of 600 µm with sieves.

A mixture of *N. tabacum* and *P. guineense* was prepared and another mixture containing *V. amygdalina* and *O.grattissimum* was prepared. The percentage ratio of these combination in mixture were 0:100, 20:80, 40:60, 50:50, 60:40, 80:20 and 100:0 respectively, corresponding to powder weight of 3 g.

The powder was measured into plastic vials containing 20g of uninfested maize and thoroughly mixed by manual agitation of the vials. A control experiment containing no plant powder was also set up. Each treatment was replicated four times in a completely randomized design.

Six adults *S. zeamais* Motsch (3 males and 3 female) were introduced into each vial and covered with muslin cloth held tightly by the perforated cover of the vial and rubber band, to ensure adequate aeration and to prevent the insects from escaping. Mortality counts of the weevil were carried out at 1,2,5,7,14,28,35 and 42 days after treatment. Insects were prodded and when immobile were considered dead. Adult emergence was recorded.

GERMINATION TEST

Laboratory petri dishes and 9cm Whatman No.1 filter paper were sterilized in the oven for 1 hour. 20 seeds of maize grain were collected from each of the vials and soaked in distilled water for about 30 minutes.

The soaked grains were carefully placed in the petri-dishes with the aid of a forcep, then covered, and moistened daily. Percentage germination was calculated after four days

DATA ANALYSIS

Insect mortality and percentage germination were arcsine transformed to normalize the mean while adult emergence was transformed using square root transformation prior to ANOVA.

RESULTS AND DISCUSSION

Results obtained from the study on mean percentage mortality of adult *S.zeamais* Motsch treated with different proportions of *Piper guineense* and *Nicotiana tabacum* powder at 42 days after treatment is presented in table 2. The study reveals that at 14 DAT, all the treatments were significantly more toxic to *S. zeamais* than the control ($P_0 + N_0$), except the P_0+N_{100} treatment which recorded 7.0%. However at 28DAT, percentage mortality in P_0+N_{100} was not significantly different from the control, but was significantly different from the other treatments. This trend continued till 42 DAT. The result shows that mortality rate was faster as the proportion of *P. guineense* was increased in the mixtures, thus revealing that the effectiveness of the treatments reduced with reduction in *P. guineense* proportion in the mixture.

The result obtained from adult emergence (Table 3) indicates that the control and $P_0 + N_{100}$ mixture were significantly inferior to other treatments.

Treatment means were separated at 5% level of probability-using Duncan's Multiple Range Test (DMRT). However, the control recorded a significantly lower ($P>0.05$) percentage adult emergence than the P_0+N_{100} mixture. The untreated check recorded a significantly ($P> 0.05$) higher seed weight loss when compared to the other treatments. However, all mixtures containing less than 40% *P.guineense* were significantly inferior to the other treatments (table 3).

The highest percentage germination was recorded in $P_{100} + N_0$ and $P_{80} + N_{20}$ mixture and this reduced considerably with reduction in *P guineense* in the mixture. The control had the least percentage germination which gave 22.5% germination (Table 3). The order of ranking of the effectiveness of the powder mixture of *P. guineense* and *N. tabacum* on the control of *S. zeamais* in this study is as follows:- $P_{100}+N_0 > P_{80}+N_{20} > P_{60}+N_{40} > P_{50}+N_{50} > P_{40}+N_{60} > P_{20}+N_{80} > P_0+N_{100} > P_0 + N_0$. This result reveals that the effectiveness of the treatments reduces with reduction in the *P. guineense* proportion in the mixture.

This confirms the finding that *P.guineense* is a very effective plant derived insecticide against *S. zeamais* (Emeasor *et al.*, 2002; Adedire and Ajayi, 1996).The effectiveness of *P. guineense* can be attributed to contact or fumigant mode of action of organophosphates (Adedire and Ajayi, 1996). The pungency of *P. guineense* is due to the presence of a yellow alkaloid piperine and a resin chavicin as the active ingredient (Emeasor *et al.*, 2002). This active ingredient possess fumigant effect against *Callosobruchus maculatus* and *S. zeamais* (Lale, 1994). Similar effects of some plant powders as insect

The effect of the treatments on adult emergence, percentage weight loss and percentage seed germination is presented in table 5. The highest percentage adult emergence was observed in the control and this was significantly higher than the treatments $V_{100}+O_0$, $V_{50}+O_{50}$, $V_{40}+O_{60}$ and V_0+O_{100}. The weight loss in the control was significantly higher than all the treatment combinations. This result

CONCLUSION AND RECOMMENDATION

P. guineense mixture with *N. tabacum* proved potent in the control of *S. zeamais* by inhibiting oviposition and preventing adult emergence. It also protected the seeds from attack by the weevil and reduced the weight loss arising from weevil perforation and feeding on the endosperm. The viability of the maize seeds were not impaired by *P. guineense* and *N. tabacum* mixture. The mixture of *V. amygdalina* and *O. grattissimum* was not as potent as the mixture of *P. guineense* and *N. tabacum*. It is recommended that the mixture of $P_{80}+N_{20}$ be used for storage of maize

protectants have been observed in the treatment of cowpea weevils (Ofuya and Salami, 2002; Ogunwolu and Odunlami, 1996), and also in maize and rice weevils (Niber, 1994; Asawalam and Adesiyan, 2001; Jambere *et al*, 1995).

The effect of various mixture combination ratio of the leaf powder of *Vernonia amygdalina* and *Ocimum grattissimum* on adult mortality of the maize weevil *S. zeamais* at different periods after treatment are presented in Table 4. The result reveals that the treatments showed no significant difference with the control at 42 DAT (at 5% level of probability.

Showed that the treatment combinations gave some protection against weight loss to the maize seeds. In terms of percentage germination, V_{100} + O_0 (82.8%) was significantly higher than the control (38.4%). The data presented showed that *O. grattissimum* alone gave the best inhibition to the emergence of adult *S. zeamais,* the treatment combinations reduced loss in seed weight, while seed germination was best in the treatment of *V. amygdalina* alone. grains to achieve synergistic effects although $P_{100}+N_0$, on it's own was very efficacious. Further research needs to be carried out on efficacy of mixtures of plant powders.

Table 1: Plant materials used for the study

Scientific names	Common names	Family	Part used
Vernonia amygdalina	Bitter Leaf (Onugbu)	Compositae	Leaves
Piper guineensis	Black Pepper (Uziza)	Piperaceae	Seed
Nicotiana tabacum	Tobacco (Utaba)	Solanaceae	Leaves
Ocimum grattissimum	Basil (Nchanwu)	Labiatae	Leaves

Table 2: Mean Percentage Mortality of Adult *Sitophilus zeamais* (Motsch) treated with different proportions of *Piper guineense* and *Nicotiana tabacum* powder at 1,2,5,7,14, 21,28,35 and 42 days after treatment.

	Days after treatment								
Treatments	1 DAT	2 DAT	5 DAT	7 DAT	14 DAT	21 DAT	28 DAT	35 DAT	42 DAT
$P_{100}+N_0$	45.7a(42.56)	97.2a(80.33)	98.60a(83.11)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)
$P_{80}+N_{20}$	1.4b(6.89)	45.7b(42.56)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)
$P_{60}+N_{40}$	1.4b(6.89)	24.5bc(26.68)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)
$P_{50}+N_{50}$	0b(1.15)	4.8cd(12.64)	87.0b(68.84)	98.60a(83.11)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)
$P_{40}+N_{60}$	0b(1.15)	7.0cd(15.42)	84.2b(66.56)	98.60a(83.11)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)
$P_{20}+N_{80}$	0b(1.15)	1.4d(6.89)	9.7c(34.04)	87.0b(68.84)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)	99.96a(88.85)
P_0+N_{100}	0b(1.15)	0d(1.15)	0d(1.15)	1.4c(6.89)	7.0b(15.42)	7.0b(15.42)	12.4b(20.64)	35.3b(36.48)	63.2b(52.66)
P_0+N_0	0b(1.15)	0d(1.15)	0d(1.15)	0c(1.15)	0c(1.15)	0c(1.15)	7.0b(15.42)	32.8b(34.90)	41.6b(40.12)

* Figures in parenthesis are arc sine transformed values.
* Means in the same column followed by the same letter are not significantly different at P>0.05 using DMRT.

Table 3: Relative efficacies of Mixture containing different proportions of *P. guineense* and *N. tabacum* powder against *S. zeamais* at 42 days after treatment.

Treatments	Mean Percentage of Adult emergence	Mean Percentage loss in seed weight	Mean Percentage seed germination
$P_{100}+N_0$	0.20c	0.01c (0.51)	99.96a (88.85)
$P_{80}+N_{20}$	0.36c	0.10c (1.81)	99.96a (88.85)
$P_{60}+N_{40}$	0.43c	0.07c (1.48)	97.85ab (81.59)
$P_{50}+N_{50}$	0.20c	0.07c (1.53)	98.55ab (82.96)
$P_{40}+N_{60}$	0.81bc	0.11c (1.93)	90.30b (71.85)
$P_{20}+N_{80}$	2.20bc	0.45b (3.84)	90.70b (72.18)
P_0+N_{100}	4.37b	0.61b (4.47)	62.70c (52.36)
P_0+N_0	44.35a	6.60a(14.88)	22.50d (38.27)

* Figures in parenthesis are arcsine transformed values.
* Means in the same column followed by the same letter are not significantly different at P>0.05 using DMRT.

Table 4: Mean Percentage Mortality for adult *S. zeamais* treated with different proportions of *V. amygdalina* and *O. grattissimum* leaf powder at 1,2,5,7,14,21,28,35 and 42 days after treatment.

	Days after treatments								
Treatments	*1 DAT*	*2 DAT*	*5 DAT*	*7 DAT*	*14 DAT*	*21 DAT*	*28 DAT*	*35 DAT*	*42 DAT*
$V_{100}+0_0$	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	1.4ab(6.89)	4.80a(12.64)	4.8b(12.64)	27.7a(31.78)
$V_{80}+0_{20}$	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0b(1.15)	1.40a(6.89)	32.2ab(34.50)	54.2a(47.44)
$V_{60}+0_{40}$	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0b(1.15)	0.0a(1.15)	19.8ab(26.68)	58.5a(49.88)
$V_{50}+0_{50}$	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0b(1.15)	0.0a(1.15)	24.5ab(29.68)	37.4a(37.68)
$V_{40}+0_{60}$	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0b(1.15)	0.0a(1.15)	45.7a(42.56)	54.8a(47.78)
$V_{20}+0_{80}$	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0b(1.15)	0.0a(1.15)	7.0b(15.42)	45.2a(42.22)
V_0+0_{100}	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	4.80a(12.64)	4.80a(12.64)	31.3ab(34.04)	35.9a(36.82)
V_0+0_0	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0a(1.15)	0.0b(1.15)	0.0a(1.15)	7.0b(15.42)	23.2a(28.82)

*Figures in parenthesis are arc sine transformed values

* Means in the same column followed by the same letters are not significantly different at P>0.05 using DMRT

Table 5: Relative efficacies of Mixture containing different proportions of *V. amygdalina* and *O.grattissimum* leaf powder against *S. zeamais* at 42 days after treatment

Treatments	Mean Percentage of Adult emergence	Mean Percentage loss in seed weight	Mean Percentage seed germination
$V_{100}+O_0$	20.68 bc	2.00c (8.05)	82.80a (65.47)
$V_{80}+O_{20}$	29.71 abc	2.05 c (8.22)	66.20ab (54.46)
$V_{60}+O_{40}$	31.60 ab	2.00 c (8.19)	77.80ab (61.23)
$V_{50}+O_{50}$	21.35 bc	1.90 c (7.93)	67.60ab (55.34)
$V_{40}+O_{60}$	23.89 bc	1.80 c (7.67)	71.80ab (57.91)
$V_{20}+O_{80}$	34.23 ab	2.15c (8.42)	50.10ab (45.06)
V_0+O_{100}	17.31c	6.60b (14.88)	57.80ab (49.47)
V_0+O_0	43.84a	12.0a (20.30)	38.40b (38.27)

*Figures in parenthesis are arc sine transformed values.
*Means in the same column followed by the same letter are not significantly different at P>0.05 using DMRT.

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