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# DEPTH OF INFESTATION BY THE ANGOUMOIS GRAIN MOTH *Sitotroga cerealella* INTO PADDY, SORGHUM AND CUMBU GRAIN LAYERS

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**ABSTRACT**

Depth of infestation by the Angoumois grain moth, *Sitotroga cerealella* (Oliver) into the different layers of both resistant and susceptible varieties of paddy, sorghum and *cumbu* was studied in laboratory using mylar film cylinders. Hundred eggs in a strip of cloth were placed at top of each column of grain and infestation was sustained for 10 weeks. Depth of infestation was more in susceptible varieties of paddy (10 cm), sorghum (7 cm) and *cumbu* (5 cm), which was 3 cm, 2 cm and 1 cm more than that was observed in the resistant variety of respective grains.

KEY WORDS: Angoumois Grain Moth, *Sitotroga cerealella*, Paddy, Sorghum, *Cumbu*, Depth of Infestation.

Cereals are usually stored in bulk after harvest, either for consumption or for marketing purpose. The angoumois grain moth (AGM), *Sitotroga cerealella* (Olivier) (Gelechiidae : Lepidoptera) is known to cause considerable damage to them especially when they are stored as unthreshed (Oxley, 1950, Doggett, 1957, 1958;). In bulk storage, the extent of damage due to the AGM is slight compared to that caused by curculionid weevils and some secondary pests. This is generally known, but the exact role played by this moth in damaging grain stored in bulk has not been systematically established. When the grain was covered by ordinary sack cloth, oviposition and subsequent penetration into the grain was not prevented (McFarlane, 1956). Therefore, in bagged grains, the superficial layers would still be subjected to infestation. Adults of AGM are small, delicate insects whose movement within grain is limited to short distances if selfdestruction is to be avoided. For this reason, in compacted grain, the emerging adult experiences difficulties in extricating itself and spread out its wings for aeration to render them functional.So, the present investigation was taken up to find out the depth of infestation by the AGM in different layers of both resistant and susceptible varieties of paddy, sorghum and *cumbu*.

## MATERIALS AND METHODS

Depth of infestation by the AGM was investigated by introducing known number of eggs. (1930). Cylinders to support columns of grains were constructed using mylar film sheets. The cylinders (30 x 6 cm) were sectioned into rings. They were then filled up with one of the three types of grains to a depth of 10 cm. Three replications were maintained for each test. The number of grains in each section was on an average 1011 grains of paddy, 1179 grains of sorghum and 3524 grains of *cumbu*. The following varieties, CO 32 (paddy), K 5 (sorghum), K2 (*cumbu*) - all resistant and Co 44 (paddy), Co 26 (sorghum), WCC 75 (*cumbu*) - all susceptible were used. Hundred eggs in a strip of cloth were placed at the top of each column in a central position. Infestation was sustained for 10 weeks, during which approximately two generations of the pest developed. Observations were made on the number and the percentage of damaged grains at different depths of the grain (Muhihu, 1984).

## RESULTS AND DISCUSSION

### Depth of infestation

### Paddy

Larvae of the AGM bored through the entire depth of 10 cm in the susceptible variety (CO 44) whereas the depth of infestation was only 7 cm in resistant variety (CO 32) during the same period (Table 1). The average percentage of damaged grains was 4.68 and 3.89 respectively in the susceptible and resistant varieties. As the depth of the grain increased, the level of infestation decreased.

Table 1. Depth of infestation and percentage of grains damaged by the AGM in resistant and susceptible varieties of paddy, sorghum and *Cumbu*[1]

| Depth (cm) | Variety | | | | | |
|---|---|---|---|---|---|---|
| | Resistant | | | Susceptible | | |
| | Paddy | Sorghum | *Cumbu* | Paddy | Sorghum | *Cumbu* |
| 1 | 32.67 (34.92)$^{f}$ | 22.83 (28.56)$^{d}$ | 10.50 (18.92)$^{d}$ | 37.67 (37.91)$^{e}$ | 29.51 (32.95)$^{e}$ | 16.60 (24.08)$^{e}$ |
| 2 | 2.91 (9.17)$^{c}$ | 3.04 (10.17)$^{c}$ | 2.88 (9.96)$^{c}$ | 4.19 (11.92)$^{d}$ | 2.62 (9.47)$^{d}$ | 3.37 (10.72)$^{d}$ |
| 3 | 1.70 (7.70)$^{d}$ | 1.58 (7.22)$^{b}$ | 0.81 (5.41)$^{b}$ | 2.63 (9.01)$^{c}$ | 2.08 (8.51)$^{cd}$ | 2.01 (8.20)$^{c}$ |
| 4 | 0.94 (5.87)$^{c}$ | 0.20 (3.11)$^{a}$ | 0.13 (2.72)$^{a}$ | 0.77 (5.32)$^{b}$ | 1.69 (7.64)$^{c}$ | 0.91 (5.72)$^{b}$ |
| 5 | 0.38 (3.91)$^{b}$ | 0.23 (2.92)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.68 (5.07)$^{b}$ | 0.99 (5.94)$^{b}$ | 0.16 (2.93)$^{a}$ |
| 6 | 0.18 (2.95)$^{ab}$ | 0.0 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.25 (3.38)$^{a}$ | 0.18 (2.97)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 7 | 0.11 (2.56)$^{ab}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.19 (3.09)$^{a}$ | 0.18 (2.97)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 8 | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.16 (2.89)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 9 | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.12 (2.70)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 10 | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.16 (2.89)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ |

[1] Mean of three replications
Figures in parentheses are Arcsin $\sqrt{\text{percentage}}$ transformed values
In a column, depth followed by common letter(s) do not differ significantly (P=0.05) DMRT
AGM : Angoumois grain moth

In the resistant CO 32, the level of infestation at the surface of the grain was 32.67 per cent which got progressively decreased to 2.91,1.70, 0.94, 0.38, 0.18 and 0.11 per cent at 2, 3, 4, 5, 6 and 7 cm depth respectively. The infestation levels in the top four divisions were significantly different among themselves. As in resistant variety, infestation was more in the first three divisions, *via.*, 37.67 per cent (1 cm), 4.19 per cent (2 cm) and 2.63 per cent (3 cm), whereas the level of infestation was less than one per cent in the remaining divisions. However, the level of infestation in the last division of the susceptible variety was higher than that in the resistant variety.

## SORGHUM

Penetration of the grain heap by the larvae of paddy. It was able to penetrate 5 cm deep in the resistant variety (K5) and 7 cm deep in the susceptible variety (CO 26). The level of infestation was more in the first division of both resistant and susceptible varieties which was significantly more than in other divisions. In both, there was a steep reduction in the level of infestation in the second division itself, tapering to mere 0.23 and 0.18 per cent in the respective last divisions of the resistant and susceptible varieties of sorghum (Table 1).

## *Cumbu*

The depth and level of infestation in *cumbu* grain columns was less than that observed in paddy and sorghum. The depth of infestation was 5 cm deep in the susceptible WCC 75, one cm more than

sorghum, the level of infestation was more on the surface layer than in lower layers. As the larvae of AGM penetrated the deeper layers of the grain, the differences found in the upper layers disappeared (Table 1).

## Depth x Media interaction

The influence of the medium on the depth of infestation by the AGM was more marked (Table 2). Apparently, paddy was the most appropriate host for the AGM as it had permitted the penetration of the entire column of 10 cm, whereas it was able to penetrate only half the distance in *cumbu* and a little deeper in sorghum. The suitability of paddy as the favoured medium was also evident from the level of infestation observed. The maximum level of infestation in paddy was 35.17 per cent which was 9 and 22 per cent more than that of sorghum and *cumbu* respectively. In all the media, the infestation percentage given was the average of the resistant and susceptible varieties.

**Table 2. Effect of medium of grains on the depth of infestation by the AGM[1]**

| Depth (cm) | Medium | | |
|---|---|---|---|
| | Paddy | Sorghum | *Cumbu* |
| 1 | 35.17 (36.42)$^{c}$ | 26.17 (30.76)$^{c}$ | 13.55 (21.50)$^{c}$ |
| 2 | 3.55 (10.55)$^{d}$ | 2.83 (9.82)$^{d}$ | 3.13 (10.34)$^{d}$ |
| 3 | 2.17 (8.36)$^{c}$ | 1.83 (7.87)$^{c}$ | 1.41 (6.81)$^{c}$ |
| 4 | 0.86 (5.60)$^{b}$ | 0.95 (5.40)$^{b}$ | 0.52 (4.22)$^{b}$ |
| 5 | 0.53 (4.49)$^{b}$ | 0.61 (4.43)$^{b}$ | 0.08 (2.37)$^{a}$ |
| 6 | 0.21 (3.17)$^{a}$ | 0.09 (2.39)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 7 | 0.15 (2.83)$^{a}$ | 0.09 (2.39)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 8 | 0.07 (2.35)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 9 | 0.06 (2.25)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ |
| 10 | 0.07 (2.35)$^{a}$ | 0.00 (1.81)$^{a}$ | 0.00 (1.81)$^{a}$ |

[1] Mean of three replications
Figures in parentheses are Arcsin $\sqrt{\text{percentage}}$ transformed values
In a column, depth followed by common letter(s) do not differ significantly (P=0.05) DMRT

## Variety x Media interaction

The interaction effect of resistant and susceptible variety in different media was also significant. In all the three media, resistant varieties differed significantly from susceptible varieties recording lower infestation level (Table 3). In paddy, the average infestation level was 3.89 per cent (resistant) and 4.68 per cent (susceptible); in sorghum, 2.79 per cent (resistant) and 3.73 per cent (susceptible) and in *cumbu*, it was 1.43 per cent and 2.31 per cent respectively in resistant and susceptib le varieties.

## Variety x Depth interaction

The data on the influence of the variety on the depth of infestation are set out in Table 4. As expected, the susceptible variety was penetrated through the entire column and penetration was confined to seven cm in the resistant variety. Marked variations were noticed only in the upper four divisions in both varieties.

**Table 3. Effect of resistant and susceptible varieties on the infestation level by the AGM in different media of grains[1]**

| Medium | Variety | |
|---|---|---|
| | Resistant | Susceptible |
| Paddy | 3.89 (7.25)$^{c}$ | 4.68 (8.42)$^{c}$ |
| Sorghum | 2.79 (6.10)$^{b}$ | 3.73 (7.59)$^{b}$ |
| *Cumbu* | 1.43 (4.79)$^{a}$ | 2.31 (6.07)$^{a}$ |

[1] Mean of three replications
Figures in parentheses are Arcsin $\sqrt{\text{percentage}}$ transformed values
In a column, media followed by common letter(s) do not differ significantly (P=0.05) DMRT

Table 4. Effect of varieties on the depth of infestation by the AGM[1]

| Depth (cm) | Variety | |
|---|---|---|
| | Resistant | Susceptible |
| 1 | 22.00 (27.47)[f] | 27.93 (31.65)[f] |
| 2 | 2.95 (9.77)[e] | 3.39 (10.70)[e] |
| 3 | 1.36 (6.76)[d] | 2.24 (8.58)[d] |
| 4 | 0.42 (3.90)[c] | 1.13 (6.23)[c] |
| 5 | 0.20 (2.88)[b] | 0.61 (4.65)[b] |
| 6 | 0.06 (2.19)[b] | 0.14 (2.72)[a] |
| 7 | 0.04 (2.06)[b] | 0.12 (2.62)[a] |
| 8 | 0.00 (1.81)[a] | 0.05 (2.17)[a] |
| 9 | 0.00 (1.81)[a] | 0.04 (2.11)[a] |
| 10 | 0.00 (1.81)[a] | 0.05 (2.17)[a] |

[1] Mean of three replications

Figures in parentheses are Arcsin $\sqrt{\text{percentage}}$ transformed values

In a column, depth followed by common letter do not differ significantly (P=0.05) DMRT

AGM : Angoumois grain moth

Failure of the adult to emerge from the grain mass may affect the copulation and egg laying may be less inhibited. If the space is limited, then the wing spreading becomes difficult. Infestation extended to the deeper layers in paddy where the infestation was higher and was most superficial in *cumbu*. Eggs of *S.cerealella* are normally laid on grains, but the eggs may get detached and fall between grains, so that deeper infestation is achieved in this way, which depends on the relative size of the intergrangular space. Less intergranular space reduces the insect infestation due to slow air movement (Pradhan, 1967). This space may be more in paddy due to the irregular arrangement of individual grains under storage conditions and less in sorghum and *cumbu* due to their small size and round shape, which may lead to more compactness of grains under storage conditions. The first instar larvae of this moth, upon emergence, does not travel far before penetrating grains (Simmons and Ellington, 1933) and, therefore, this may not itself determine the depth of infestation. However, Shajahan (1975) allowed *S.cerealella* to multiply for 6-9 months on stored unhusked rice, in which time, the infestation has reached a depth of 22.8 cm but there was only 1.7 per cent grain damage at that level. Muhihu (1984) observed the depth of infestation to be 12 cm, 6 cm and 5.5 cm in columns of maize, sorghum and wheat grain respectively. Harris (1943) indicated that infestation by the AGM was enhanced by presence of large open spaces, which created suitable ecological habitats for the pest. The other reasons may include the reduced exposure to the moth, absence of proper aeration in deeper layers and heat development in deeper layers under storage conditions.

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