ENTOMOLOGY

Increases in the Incidence of *Atherigona indica infuscata* Emden Diptera (Anthomyiidae) on Sorghum due to Spraying

Central shoot fly, *Atherigona indica infuscata* Emd., is a serious pest of sorghum in the Old World. It is extremely common in East Africa and has been recorded from *Brachiaria brizantha*[1], *Sorghum verticilliflorum*, *Eleusine coracana*, *Pennisetum typhoides*, *Zea mays*[2], as well as cultivated sorghums. The fly is a pest of the young seedlings, and causes severe damage to the growing point. This usually leads to tillering; these tillers may or may not escape subsequent attack. If the former, the only effect is to lengthen the maturation period; if the latter, yield may be seriously affected.

Swaine and Wyatt[3] obtained some control of the pest using weekly applications of DDT/benzene hexachloride dusts in Tanzania. Ingram[4] has reported failure to control the pest at Serere, Uganda, with DDT, and was unable to correlate the degree of infestation with yields. Clinton[5] also found that insecticidal sprays failed to afford control of this Anthomyid in the Sudan. Wheatley[6], working in Kenya, has obtained control with DDT/benzene hexachloride dusts on late plantings.

In subsequent experiments at Serere, we tested three insecticides against a control treatment, namely, DDT (25 per cent ml.) at 1 lb. a.i. per acre, carbaryl (85 per cent sprayable) at 2 lb. a.i. per acre and fenitrothion (50 per cent ml.) at 1 lb. a.i. per acre. Sprays were applied 7 and 14 days from germination to sorghum planted at three dates separated by 4-day intervals. Two varieties were used, 'Serena' (*SB* 68) which shows field resistance to the pest, and 'Combine Kaffir' (*CK* 60) which is susceptible. The two experiments had different error variances and were analysed separately. Counts on random rows within harvest plots, protected by the appropriate sprayed guard rows, were made. Results are shown in Table 1.

Table 1. Mean Number of Shoots killed by *A. indica* at Fourteen Days

Planting date	Control	Carbaryl	Fenitrothion	DDT	Mean
A. 'Serena'					
1	69	56	55	51	58
2	47	68	38	86	60
3	137	303	145	286	218
Mean	84	143	79	141	112
S.E. treatment mean, ± 27·3.					
B. 'Combine Kaffir' 60					
1	64	60	34	48	52
2	70	72	66	132	86
3	87	171	127	199	146
Mean	74	101	76	126	94
S.E. treatment mean, ± 15·2.					

In both varieties late planting leads to an increase in the number of plants attacked ($P < 0·001$), but DDT and carbaryl also increase the pest attack compared with the control. Fenitrothion had no effect. The increased attack on the DDT and carbaryl treatments was significant at $P < 0·01$ on *CK* 60 and at $P < 0·05$ on 'Serena'. The effect of late planting has been observed previously, but the insecticidal effect was unexpected. DDT and carbaryl apparently control parasites or predators of *Atherigona* more efficiently than the pest itself, leading to an increase in crop damage.

There was no significant difference in the degree of infestation in the two varieties, although *CK* 60 shows less attack and the difference approaches significance. Analysis of yield data from both varieties showed that there was no significant difference between the insecticidal treatments for either variety. The regression of yield on dead hearts was significant at the 5 per cent level for *CK* 60, but not for 'Serena'. This confirms the apparent field resistance of 'Serena'. The mechanism of varietal resistance is probably a reduction in the level of attack on the secondary tillers of 'Serena'. Secondary tillers of *CK* 60 are heavily attacked, and yields are consequently affected.

Such resistance is probably possessed by many of the indigenous sorghum varieties of East Africa, and explains Ingram's result. Introduced varieties from areas where the pest does not occur are not so resistant.

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MICROBIOLOGY

Comparison of Oxygen Demand Rates and Oxygen Utilization Rates

The rate of oxygen consumption by a bacterial suspension can be measured by observing the change in concentration of oxygen in the air in contact with the culture or dissolved in the suspension. The rate of consumption is known as the oxygen demand rate which Gaden[1] defines as the maximum use of oxygen by a culture in an ideal environment. Oxygen utilization is defined by the author as the terminal use of oxygen in respiration, that is, the formation of water. In this investigation both oxygen demand and oxygen utilization of a culture of *Pseudomonas fluorescens* during respiration only were simultaneously measured.

To act as a hydrogen acceptor in respiration, oxygen must pass from the gaseous state to the dissolved state and then through a number of interfaces and obstacles all of which provide considerable resistance to its passage. Theoretically, then, oxygen utilization may occur at the same rate as oxygen demand, but should lag oxygen demand by a time factor which is dependent on the magnitude of the resistance to oxygen transfer. The purpose of the investigation reported here was to test this hypothesis.

To measure the rate at which water is formed in an environment that contains water it is necessary to use a tagged oxygen atom. The heavy isotope, oxygen-18, was used in this investigation. The method of using oxygen-18 to measure utilization rate, that is, the formation of $H_2{}^{18}O$, has already been described[2].

Manometric determinations of oxygen demand were made simultaneously with the oxygen utilization tests. The apparatus used automatically recorded the oxygen demand of the respiring culture[3].

The results of oxygen utilization and oxygen demand tests for two runs are shown in Fig. 1. It is apparent that oxygen utilization does not proceed at the same rate as oxygen demand, at least for the time period of these tests. It is evident, however, that the rate of utilization increases through the test. This is especially evident in run *B*, where the rate of utilization increases and the oxygen demand rate is constant. In run *C* the oxygen demand rate decreased during the final minutes of the run, and so the increase in oxygen utilization rate is not as

Table 1. Percentage Production of $H_2{}^{18}O$

Run	Sample No.	$\frac{\text{Rate of } H_2{}^{18}O \text{ produced}}{\text{Rate of } {}^{18}O \text{ consumed}}$ (per cent)
B	2	22·4
	3	34·8
	4	42·7
C	5	25·1
	6	17·4
	7	44·0