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# EFFECT OF DUNG OF GOAT IN OIL PALM PLANTATIONS ON THE GROWTH OF SOIL FACULTATIVE PARASITE *SCLEROTIUM ROLFSII* SACC.

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**ABSTRACT :** Studies were carried out to find the effect dung of goats picked in oil palm plantation on the vegetative growth of soil facultative parasite *Sclerotium rolfsii*. The fungus did not grow in aqueous extracts of fresh faecal pellets of 1.0 to 5.0% and did so very feebly in extracts of lower concentration 0.05 – 5%. The mean dry weights of the fungus in the aqueous dung 10 – 20 mg were far below the mycelium dry weight of 230 mg produced in Potato Dextrose Broth. Two common agricultural wastes of the plantation, corn cob and oil palm fruit pericarp supported reasonable mycelia growth than the dung extracts. Attempts were made to improve vegetative growth in the extracts of the fresh faecal pellets with Potato Dextrose Broth (PDB). The various treatments included PDB, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5 and 5% fresh dung extract and 5.0% extract of fresh dung combined with PDB, ½ dilution PDB, ¼ dilution PDB and 1/8 dilution PDB. The various dung-PDB combinations could at best raise the growth to almost the same level in pure PDB but never beyond. It was concluded that the addition of goat dung at the concentrations used in this investigation will affect the growth of *S. rolfsii* in the field.
**Keywords :** Sclerotium rolfsii, goat dung, oil palm husk, PDB

## INTRODUCTION

The rearing of livestock, especially, cattle, goats and sheep in tree crop plantations such as oil palm (*Elaies guineensis*), *Citrus* spp., Mango (*Mangifera indica*) and coconut (*Cocos nucifera*) is a well established practice. An extensive literature documents the potential for integration of pasture and livestock in plantation agriculture (Shelton *et al*. 1987). The integration of various crops and animals enables synergistic interactions, and result in a greater additive and total contribution than the sum of their individual effects (Edwards et al., 1988) cited in Devendra, 2011.The principal advantage of integration of livestock in plantations establishment is the total farm productivity and sustainable agriculture in the context of efficient natural resource management, together with attendant benefits of reduced weeding and fertilizer costs, improved soil fertility due to the return of dung and urine and value addition to the tree crop (Devendra, 2004).

Pastures established under coconut and cattle-pasture-coconut integration have been studied by Ohler (1969), Plucknett (1979), Guzman and Allo (1975), Thomas (1978) and Reynolds (1980). Cattle and sheep are reared under oil palm in Colombia (Hove, 1966), Ivory Coast (Rombaut, 1973) and in Ghana sheep are raised under cashew, kola, mango oil palm and citrus (Asiedu *et al*. 1978) and under rubber in Malaysia (Wan Mohamed, 1982).

These plantations in the forest zone carry lush leguminous cover crops such as *Calopogonium mucunoides*, *Pueraria phaseloides* and *Centrosema pubescens*, and non leguminous species including *Aspillia arficana* and *Panicum maximum*. Such cover crops grow profusely and have to be cut down regularly, which is an expensive operation (Devendra, 1991). The animals are introduced to keep grass and weeds short to prevent excessive nutrient and moisture competition with the plants.

The cover vegetation obviously serves as a good fodder that could support livestock. Tan and Abraham (1981) found the percentage decline in undergrowth cover in grazing treatments either rotationally or free range to be twice as much as in the field where no sheep were kept. This practice is the most benign production system from environmental perspective. Apart from the direct benefits of obtaining animal products such as meat, milk, and skins, there are several advantages of integrating animals with perennial crops. The animals in essence, by feeding controlled weed growth thereby saving labour cost and also reduce the use of herbicides. Reduced herbicides usage means reduced maintenance cost and less environmental contamination and pollution (Azid, 2008). Droppings of the animals, as manure, enrich the soil, thus saving the farmer from expensive fertilizer inputs and above all increase land productivity and income to farmers. The animal-crop interactions in the mixed system also offer a great opportunity to expand the goat and sheep industry.

In spite of the numerous advantages associated with the above practice, any demerits that may be associated with it must be examined. Most studies have been centred on the growth of the plants (Tan and Abraham, 1981), weed control by the animals (Tan and Abraham, 1981) damage by the grazing animals (Tan and Goh 1988) and economies of combined grazing and chemical control (Ani Arope *et al*. 1985). One area that has not been studied is the effect of the dropping of the animals on the soil microflora and microfauna whose activities in one way or the other influence the productivity of the crops. Soil fungi break down organic matter releasing the component nutrients which are used by the plants. If the dung contains favourable compounds, the microorganisms might gain by its addition to the soil. On the other hand it may contain toxic compounds which will inhibit their growth. It may contain neither of these and will then have no chemical effect at all on the fungus.

The objective of this study was to determine the effect of the dung of goat on growth of the common soil facultative parasite, *Sclerotum rolfsii*, which is a fast growing fungus and commonly forms a heavy whitish growth on the upper layers of the soil. This fungus was selected because it is most likely to come into contact with the droppings of the herds of goat which could accumulate in the grazing area.

## MATERIALS AND METHODS

### *Sclerotium rolfsii*

The fungus used for the present study was isolated from naturally infected palm husk pericarp and identified as *S. rolfsii* and stored on potato dextrose agar slants. The fungus was further sub-cultured by growing on freshly prepared PDA plates. The fresh PDA was prepared following the method of Sarma *et al*. (2002). The fungus was cultured on Potato Dextrose Agar (PDA) plate and 3 mm disc of mycelium was removed for the experiment from the growing edge of a 4-day culture.

### Goat dung

The goat dung used in this investigation was obtained from goat farm in conjunction with oil palm plantation in the Eastern Region of Ghana. The dung was placed in new re-sealable polyethylene bags and sent to the laboratory.

### Solid medium test

Fifty grams of the fresh dung was pulverised in a mortar and. Two hundred millilitres of distilled water was then added to the pulverized dung in a 500 m beaker. It was then passed through a 4-ply muslin cloth and then filtered through Whatman's filter paper No 4.

Goat dung extracts of concentrations 0.1, 0.2, 0.3, 0.4. 0.5, 1.0, 2.0. 3.0, 4.0 and 5.0% were prepared. The Petri plates were then inoculated at the centre of the plates with 3 mm circular discs of mycelium removed from the margin of an actively growing 4-day old culture with a flamed cork borer. There were four replicates from each dilution level. The plates were incubated at 30 $^{o}$C and the diameter of the fungus growing in the Petri plates was measured at two day intervals for 5 days.

**In vitro test**

Potato Dextrose Broth was amended with the dung to obtain concentrations of 0.05, 0.1, 0.2, 0.3, 0.4. 0.5, 1.0, 2.0. 3.0, 4.0 and 5.0%. Erlenmeyer flasks (250 ml) containing 30ml of appropriate dilution of the extract were plugged with non absorbent cotton wool and sterilized at 121 $^{o}$C, 1.1kg/cm$^3$ for 25 minutes. The flasks were then inoculated with 3 mm discs of 4-day old culture of the test fungus and incubated at 30 $^{o}$C. At pre-determined incubation periods of 1, 2, 3, 4 and 5 days, three flasks were removed and the mycelium harvested using oven dried and pre-weighed Whatman No. 2 filter papers. Filter papers carrying the harvested mycelia were put in an electrically heated oven (Gallenkamp oven plus series) at 75 $^{o}$C for 24 hours. The dry weight of the mycelium was then calculated by the difference in weight.

**Corn cob and oil palm fruit husk**

The corn cod nad oil palm fruit husk were ground separately into a meal in a mortar. The bottom of the Petri plate was filled in each case with the material and compacted to a dept of 5 mm. Enough (10 ml) distilled water was added so that the material was wet to the touch and then autoclaved at121 $^{o}$C, 1.1kg/cm$^3$ for 25 minutes. Each Petri dish was inoculated with a 3 mm disc culture od *S.rolfsii* and and incubated at a temperature of 30$^{o}$C. There were four replicate dishes for each treatment.

**Data analysis**

The data were statistically analyzed by analysis of variance. Means were compared using LSD test at 5% level of significance.

**RESULTS**

The influence of goat dung extract on growth of *S. rolfsii* was investigated using different concentrations of the extract. The findings of this investigation are quite remarkable. Growth did not occur in the dung-agar medium concentrations of 1.0-5% after 5 days of incubation (Table 1). The higher concentrations of the dung used initially might have been of high osmotic potential. In the control plate, the fungus covered the entire Petri plate during the period of incubation. Growth of the fungus on PDA, oil palm fruit husk and corn cob meal was superior to the goat dung extract at concentrations of 1.0-5.0% (Table 1). Even though there was growth on the corn cob and the oil palm fruit husk, the sparse mycelia differed markedly from the control.

Table 1: Growth of *S. rolfsii* on goat dung, corn cob meal and oil palm fruit husk at 30$^{o}$C

| Medium | Mean diameter of cultures (mm) after the following days of incubation | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Dung - agar(% dung) | | | | | |
| 1.0 | - | - | - | - | - |
| 2.0 | - | - | - | - | - |
| 3.0 | - | - | - | - | - |
| 4.0 | - | - | - | - | - |
| 5.0 | - | - | - | - | - |
| Corn cob | - | 31.8 | 53.8 | 76.3 | 87.5 |
| Oil palm fruit husk | - | 25.5 | 50.5 | 67.8 | 85.2 |
| PDA | 23.9 | 62.0 | 87.0 | 90.0 | 90.0 |

- No growth

As a result of the failure of growth of *S. rolfsii* in the initial concentrations of the dung extracts, further dilutions were made to achieve the concentrations (0.05, 0.10, 0.20, 0.30, 0.40, 0.50%) and used subsequently as in the previous experiment. The results showed that some amount of growth occurred but it was very poor in the dung media and significantly lower than that in the PDB (Table 2). It is clear that higher concentrations of goat dung did not enhance growth of *S. rolfsii* and there was no significant difference in the mean dry weight of mycelium in different dung concentrations (0.05 – 0.5%). However a significant ($P \leq 0.05$) difference was observed in the different dung concentrations when compared to the PDB. The pH of the culture medium drifted markedly to the acidic region with the minimum pH of 2.36 supporting the maximum dry weight of 230mg (Table 2).

Table 2: Vegetative growth of *Sclerotium rolfsii* in goat dung solution at 30°C for 8 days

| Dung concentration (%) | pH of medium | | Mean dry weight of mycelium ± Standard error (mg) |
|---|---|---|---|
| | Initial | Final | |
| 0.05 | 7.00 | 3.80 | $20.6 \pm 0.27^{b}$ |
| 0.1 | 7.25 | 3.85 | $20.4 \pm 0.06^{b}$ |
| 0.2 | 7.97 | 3.89 | $19.3 \pm 0.03^{b}$ |
| 0.3 | 8.14 | 4.32 | $19.1 \pm 0.17^{b}$ |
| 0.4 | 8.24 | 6.64 | $18.5 \pm 0.24^{b}$ |
| 0.5 | 9.38 | 7.66 | $17.3 \pm 0.20^{b}$ |
| PDB | 6.35 | 2.36 | $230 \pm 2.08^{a}$ |

Means fallowed by different letters were significantly different according to the LSD test (P = 0.05).

Growth of *S. rolfsii* in the goat dung extracts of concentration between 0.05 and 0.5% was poor, which could be due to two possible causes. Either the extract did not contain sufficient nutrients to support growth of the fungus or inhibitory compounds were present in the extracts. Either condition could be corrected by the addition of nutrients. If nutrients are of sufficiently high levels, their effects could overcome that of the inhibitory compounds.

Table 3: Growth of *S. rolfsii* in goat dung agar medium amended with PDA at room temperature (30°C)

| Dung concentration (%) | Mean diameter of cultures (mm) after the following days of incubation | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| 0.05 | 16.1 | 41.0 | 75.5 | 90.0 | 90.0 |
| 0.10 | 15.8 | 40.5 | 72.3 | 90.0 | 90.0 |
| 0.20 | 15.5 | 40.2 | 71.8 | 90.0 | 90.0 |
| 0.30 | 15.3 | 40.0 | 70.5 | 88.5 | 90.0 |
| 0.40 | 15.2 | 38.8 | 70.1 | 88.1 | 90.0 |
| 0.50 | 15.0 | 38.5 | 70.0 | 87.8 | 90.0 |
| PDA(Control) | 22.0 | 58.7 | 90.0 | 90.0 | 90.0 |

Interestingly growth of *S. rolfsii* on PDA amended with different concentrations of the dung extract did not differ much from the unamended PDA. By the end of the incubation period, the different treatments as well as the control had fully covered the Petri plate (90mm). Whilst it took *S. rolfsii* three days to fully cover PDA medium a longer period (four days) was used by the fungus to cover the plate in the amended PDA media.

Table 4: Growth of *Sclerotium rolfsii* in 5% (w/v) fresh dung agar medium amended with different concentrations of PDA at 30°C

| Concentrations of PDA | Mean diameter of cultures (mm) after the following days of Incubation | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Full strength | 16.8 | 41.4 | 72.0 | 90.0 | 90.0 | 90 |
| 1/2 strength | 12.0 | 33.5 | 56.5. | 66.8 | 81.5 | 90 |
| 1/4 strength | 11.5 | 26.8 | 44.2 | 59.5 | 75.8 | 90 |
| 1/8 strength | 11.5 | 24.5 | 36.0 | 55.3 | 71.5 | 90 |

It was assumed that if inhibitory compounds were present, they could not be equally potent at the concentrations. Consequently, the dung was amended with full strength, ½ dilution, ¼ dilution and 1/8 dilution of PDA to investigate the failure of the dung to support the growth of mycelium of *S. rolfsii*. The results showed that the fungus grew in all the media, and the growth in the media containing the dung was inferior to that of the dung free media. Further dilution of the amending medium (PDA) resulted in slower growth of *S. rolfsii*. It took the test fungus a much longer period (6 days) to fully cover the entire Petri plate whereas in the control 4 days were used to cover the entire plate (Table 4).

## DISCUSSION

Keeping livestock under perennial crops is a familiar practice in tropical and sub-tropical areas of the world. The successful integration of tree-crop plantation and animal rearing requires that the grazing livestock can be used as an aid in the management of the tree crop plantation and the joint income of the two endeavours is greater than obtained from the plantation alone.

According to Azizol (2001) the integration of livestock in crop plantations such as oil palm has benefited farmers especially in saving labour cost up to 50%. The herds of sheep and goat can be large and large quantities of faecal pellets are likely to accumulate in the grazing area. The droppings of the animals under such plantations may come into contact with microorganisms that are an integral part of the decomposition process and are important in the release of nutrients from litter and soil organic matter. Among the terrestrial decomposer communities, fungi are known to have the dominant microbial biomass.

*Sclerotium rolfsii* grows, survives, and attacks plants at or near the soil line. Before the fungus penetrates host tissue it produces a considerable mass of mycelium on the plant surface, a process which can take 2 to 10 days (Agrios, 1978). The goat dung comes into contact with the exposed mycelium of *S. rolfsii* on the forest floor.

Animal dung has its own resident coprophilous fungi, but the fact that different fungi associate with particular types of dung is an indication that animal dung can not be a suitable substrate for any fungal species that happens to come in contact with it. The fresh dung may contain nutrients which may promote growth, or inhibit growth as a result of toxic compounds. The third possibility is that the dung may contain neither of these and will have no chemical effect at all on the fungus, but physical in cutting off light. According to Gautum and Kolte (1979) adding organic amendments such as oat straw or cruciferous plants (Stapleton and Duncan, 1998) limits disease incidence due to *S. rolfsii* and might be useful in controlling *S. rolfsii* in small-scale agricultural systems (Daami-Remadi *et al* 2007**)**.

Growth of *S. rolfsii* occurs within a broad pH range, though best on acidic soils. The maximum mycelium dry weight of *S. rolfsii* (230mg) was recorded at pH of 2.36 in the PDB medium. Although the optimum pH range for mycelial growth had been found to be 3.0 to 5.0, and *sclerotial* germination occurs between 2.0 and 5.0 (Agrios, 1978). Germination is inhibited at a pH above 7.0 whereas maxiumum mycelial growth occurs between 25°C and 35°C with little or none at 10 or 40°C (Agrios, 1978).

Goat dung is one of richest source of nutrients used in soil enrichment. A study conducted by Mkile (2001), showed that, of the nutrient composition of different manures, cattle manure had the lowest N, P and K contents followed by sheep, and goat manure had the highest content of N, P and K. In spite of the rich nutrients content of goat dung, *S. rolfsii* failed to grow in the higher concentrations of the extracts; this may be ascribed to inhibitory substances. However marginal growth of the fungus was achieved following amendment with PDB but not comparable to control (PDB).

Siddiqui (2004) also showed that composted goat dung was better in reducing nematode multiplication and improving plant growth than horse dung. It is reassuring that the dung of goat does not encourage the growth of *S. rolfsii* and therefore be considered as one of the ways of controlling the soil pathogenic fungus (*S. rolfsii*) which causes serious yield loss in crops of high economic importance (Maurya *et al*., 2010).

## Conclusion

The results of the study clearly showed that higher concentrations (1.0 to 5.0%) of the goat dung extract completely inhibited the growth of *S. rolfsii.* It can therefore be said the goat dung could be used to control the growth and development of soil-borne pathogenic fungus *S. rolfsii* and thereby reduce the incidence of disease whilst at the same time enriching soil with valuable nutrients (N, P, and K) for plants growth.

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