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**EFFECT OF FERTILIZER RATES ON THE INCIDENCE OF INSECT PESTS OF
SORGHUM BICOLOR (L) MOENCH IN THE NORTHERN REGION OF GHANA**

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Abstract

Physiological susceptibility of crops to insect pests may be affected by the form and level of fertilizer used. The study was to identify the insect pests of some newly improved varieties of sorghum and evaluate the effect of different fertilizer rates of inorganic fertilizer on the pests in northern region of Ghana. The experiment was undertaken within the Yendi and Savelugu-Nanton Municipalities of the region in a split plot design with four replicates at each site. Fertilizer levels served as the main plots and varieties as the subplots. Three varieties of sorghum namely, Kapaala (improved variety), Dorado (improved variety) and Kadaga (farmer variety) were used. Three fertilizer rates were also used. These were higher rate (250 kg NPK +250 kg SA/ha) recommended rate (250 kg NPK +125 kg SA/ha) and no fertilizer (as control). Data was collected fortnightly throughout the growing season of the crop and the insect pests and their numbers were recorded. Insects identified on the sorghum crops within both Yendi and Savelugu districts were grasshoppers, stemborers, leafminers, headbugs, midges, spittle bugs and others such as beetles and planthoppers. There were significant differences in the effects of the three fertilizer rates on the incidence of the different insects identified. However considering a particular insect species the fertilizer rates did not show marked differences in their effects. Midges and headbugs highly infested Kapaala and Dorado varieties than the Kadaga variety. The observation was attributed to the relatively compact heads of Kapaala and Dorado varieties which favours oviposition of the insects.

Keywords: Sorghum, insect pests, Ghana, fertilizer rates, improved varieties

Introduction

Sorghum bicolor (L) Moench, traditionally serves as one of the staples in the Savanna zone of West Africa including Ghana. With the best adaptation to the vagaries of variable rainfall and poor soil fertility, sorghum provides the foundation for food security in these rainfed agricultural production systems. There is need to help smallholder farmers increase and secure the production of these staple crops for food and income generation. The development of newly improved varieties in addressing low productivity goes with the optimal environmental conditions and management levels used to maximize the genetic yield potential.

In the developing world, three quarters of all seed planted is derived from stocks maintained on-farm by farmers. Although these stocks provide farmers with a degree of food security, they are susceptible to losses or damage caused by insects (Feldmann *et al.*, 2009).

Biotic stresses like weeds, diseases and pests can be controlled by crop protection products and crop resistance, a practice well established in major crop production areas. Agroecologists contend that links between healthy soils and healthy plants are fundamental to ecologically based pest

management. The control of weeds, diseases and pests could be achieved by keeping the crop strong and healthy by use of chemical substances such as fertilizers.

There is possibility of changing the preference of insects by optimal plant nutritional requirement.

Fertilizers are generally critical for increased agricultural productivity. Studies such as Yardim & Edwards (2003); Jahn, (2004) and John et al., (2004) indicate that pest populations in various agro ecosystems depend on the kind of fertilizers used, the crops grown, and the insect pests present.

Thus the physiological susceptibility of crops may be affected by the form of fertilizer used (Patriquin et al., 1995).

In Ghana research on fertilizer use has mainly been related to yields. Studies on the impact of fertilizer use on the incidence of insect pests are virtually non-existent.

The study sought to identify the insect pests of some newly improved varieties of sorghum and evaluate the effect of different fertility rates of inorganic fertilizer on the pests in the Northern Region of Ghana.

Materials and Methods

Study Area

The study was carried out in two municipalities of the Northern Region of Ghana. The areas are Yendi (9° 44 8 N, 0° 0 59 W) and Savelugu-Nanton (9° 37 26.4 N, 0° 49 40.8 W) Municipalities. Generally, the Northern Region is much drier than southern areas of Ghana, due to its proximity to the Sahel and the Sahara. The vegetation consists predominantly of grassland, with clusters of drought-resistant trees such as baobabs or acacias. Between May to October is the wet season, with an average annual rainfall of 750 to 1050 mm. The dry season is between November and April. The highest temperatures are reached at the end of the dry season, the lowest in December and January. However, the hot harmattan winds from the Sahara blows frequently between December and the beginning of February. The temperatures can vary between 20°C (59°F) at night and 40°C (104°F) during the day.

Land preparation and sowing

The land was ploughed, leveled and treated with pre-emergent herbicide. The seeds of the sorghum varieties were planted in the generated randomized plots of 4.5x5m² at a spacing of 75x20cm².

Experimental Design and Fertilizer Application

The experiment was conducted in a split plot design with four replicates at each site. Fertilizer levels served as the main plots and varieties as the subplots. Three varieties of sorghum were used, Kapaala (improved variety), Dorado (improved variety) and Kadaga (farmer variety). Three fertilizer levels were also used. These were higher rate (250 kg NPK +250 kg SA/ha), recommended rate (250 kg NPK +125 kg SA/ha) and no fertilizer as control. The fertilizer was applied as 250kg/ha NPK at planting (for both higher rate and recommended rate) and the second application as 250kg/ha SA (higher rate) and 125kg/ha (recommended rate) at five weeks after planting.

Data Collection

Data collection started three weeks after planting during the 2012 cropping (wet) season. Data on insect pest population, plant damage and yield were recorded. The data was collected fortnightly throughout the growing season of the crop in a systematic sampling format (Pal and Das Gupta, 1994). 5 plants per row from the 4 middle rows per plot were used and the insect pests found were

identified and their activities, recorded. Un-identified insect pests were also collected and preserved in a specimen bottle containing 98% ethyl alcohol for later identification in the lab or by a Taxonomist. In this study however, since some of the insect pests were nocturnal and would not be observed during the day only the damage symptoms of the pests (and not the individual insect numbers) were taken into account to measure the intensity of the incidence/infestation. The intensity of the incidence was measured by the ratio of the infested plants to the total number of plants in the selected plots of the field at various stages of the growth period. Analysis of variance (ANOVA) was used to analyse the data.

Results and Discussions

Insect Pests Identified on the Sorghum Varieties

All three sorghum varieties attracted various insects throughout the growing season. Major insect pests that attacked the crops within the two municipalities were grasshoppers (GH) stemborers (SB), leafminers(LM), spittle bugs(SPB) sorghum midges (SM), headbugs (HB) and others (OT). The others were insects that were found in very minor and isolated cases. These were beetles and planthoppers. Leafminers grazed (mined) the leaf surfaces and also created patterns on the leaf surfaces of the crops. Grasshoppers were found chewing the sorghum leaves and stemborers were identified by deadhearts and the characteristic holes created on the leaf surfaces as a result of the larval feeding. The damage symptoms of leafminers, grasshoppers and stemborers were found throughout the growing period of the crops.

Sorghum midges and headbugs were the most serious pests found on the sorghum during the reproductive stage. In relation to leafminers, stemborers and grasshoppers, sorghum midge and headbugs had relatively lower incidence (Tables 1 and 2). However the effect of their infestations was very severe causing almost 100% yield loss. Several larvae of the midge were found in the glumes which resulted in many chaffy florets as in severe blast infestation (Plate 1b).



Plate 1(a): Normal sorghum head



(b): Chaffy head as a result of Midge infestation

The headbugs on the other hand caused a lot of shriveled grains and mould infestation (Plate 2a&b). Kapaala and Dorado varieties were found to be the most affected, probably due to the fact that they had more compact heads than Kadaga (the farmer variety). This confirms the observation in an earlier study by Tanzubil and (Dekuku1991).



Plate 2 (a): Headbug on developing sorghum grains (b): Shrivelled and mouldy grains as a result of headbug infestation

Fertilizer rates versus insect incidence

The insect pests seemed to be exhibiting variable incidence intensity under the three fertility levels. Judging from the LSD (0.05) values, with regards to the different types of insects, there were significant differences observed in the effects of the different fertilizer rates on pests' incidence (Table 1). However for the same insect species, there were no significant differences seen in the effects of the different fertilizer rates on the insect pests' incidence. Nonetheless, the recommended fertilizer rate (RR) seemed to have some effect on headbug (HB) incidence.

Varieties versus Incidence

Similar pattern of results described above, was observed under the variety and pest incidence correlation (Table 2).

Leafminers maintained their dominance over the other insects in terms of their incidence on the three sorghum varieties. Headbug incidence was however significantly higher in the two improved varieties (Dorado and Kapaala) than the farmer variety.

Table 1: Effects of fertilizer rates on insect pest incidence on sorghum

Fertilizer Rates	Incidence of Insects (%)						
	GH	LM	SB	HB	SM	SPB	OT
NF	4.22	5.59	4.12	1.68	1.65	2.96	2.88
RR	4.28	5.28	3.89	2.48	1.70	2.50	2.63
HR	4.32	5.24	3.82	1.91	1.73	2.45	3.19
LSD (0.05)	0.66	0.57	0.88	0.82	0.531	1.04	1.28
SED	0.30	0.26	0.40	0.37	0.24	0.47	0.59

Table key: NF=no fertilizer; RR =recommended rate, HR= Higher rate

Table 2: Insect incidence on the three sorghum varieties

Varieties	Incidence of Insects (%)						
	GH	LM	SB	HB	SM	SPB	OT
Dor	4.00	5.37	3.80	2.49	1.78	2.75	3.49
Kad	4.48	5.39	4.20	1.18	1.54	2.58	2.44
Kap	4.35	5.35	3.84	2.40	1.76	2.57	2.78
LSD	0.47	0.48	0.73	0.97	0.63	0.61	0.98
SED	0.23	0.23	0.36	0.48	0.31	0.30	0.48

Table key: Dor=Dorado; Kad =Kadaga, Kap= Kapaala

Conclusions

Grasshoppers, stemborers, leafminers, headbugs, midges, spittle bugs, sucking bugs and others such as beetles and planthoppers are the most important pests found on *Sorghum bicolor* in the northern region of Ghana.

There were significant differences in the effects of the three fertilizer rates on the incidence of the different insects identified. However considering a particular insect species the fertilizer rates did not show marked differences in their effects. This confirms studies such as Erdal & Edwards (2003); Jahn, (2004) and John et al., (2004) which indicate that pests' responses in various agro ecosystems depend on the kind of fertilizers used, the crops grown, and the insect pests present. Farmers cultivating Kapaala or Dorado varieties should however adopt the higher rate recommendation to minimize headbug infestation.

Although the identified insects attacked all the three varieties of sorghum, midges and headbugs highly infested the two improved varieties than the farmer variety, as a result of their relatively compact heads which favours oviposition of the insects.

Midges and headbugs seem to be real dangers to sorghum production and calls for interventions such as exploring the possibility of using biological control agents as management options.

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