

THE BIO-EFFICACY OF TWO HERBICIDES ON THE CONTROL OF *Colletotrichum graminicola*, THE CAUSAL ORGANISM OF SORGHUM LEAF ANTHRACNOSE

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ABSTRACT

The investigation was carried out at Botany Laboratory, Department of Plant Science, Bayero University, Kano to evaluate the bio-efficacy of two systemic herbicides (Butachlor and Glyphosate) in-vitro on the control of *Colletotrichum graminicola*, the causal organism of sorghum leaf anthracnose. Three different concentrations of the herbicides and a check (20%, 50%, 80%, and 0% or water) were prepared and amended with SDA medium, each replicated five times and laid on a Completely Randomized Design. At least 50 fungal spores were germinated on each of herbicide- SDA medium and incubated for a period of seven days. The results of the study have shown that 50% of both Butachlor and Glyphosate produced the highest inhibitory effect on the spore germination of the fungal isolate while 20% concentration of both herbicides produced little or no effect on spore germination. Similarly, at both 50% and 80% concentrations of the two herbicides, there was significant ($P < 0.05$) reduction in the mycelia length of the fungus (1.81cm, 1.21cm for 50% Butachlor and Glyphosate; and 1.93cm, 2.47cm for 80% Butachlor and Glyphosate, respectively). This suggests that both Butachlor and Glyphosate at 50% and 80% could confer protection to sorghum against leaf anthracnose caused by *Colletotrichum graminicola*.

Keywords; Bio-efficacy, in-vitro, *Colletotrichum graminicola*, herbicide, sorghum leaf anthracnose

INTRODUCTION

Sorghum leaf and stalk anthracnose also known as red stalk rot induced by the fungus *Colletotrichum graminicola* (Cesati) Wilson is an important disease of sorghum in Nigeria and all sorghum producing areas of the world (Rao et al., 2002). Anthracnose affects all plant parts including the stem, leaf, peduncle, inflorescence and grain (Gwary et al., 2002). Foliar anthracnose occurs in most areas where Sorghum is grown including North, South and Central America, West Indies, Asia and Africa (Frederiksen, 1992), including Nigeria where it is a major disease of sorghum (Marley et al., 2000). It affects a number of the grass family (Poaceae) members among some varieties of the genus *Sorghum bicolor* (Ali and Warren, 1992). Among the susceptible varieties, differences in severity of the disease occurred depending on the environment in which the varieties are grown (Bergquist, 1973; Warren, 1996; 1997).

The most common symptoms of sorghum anthracnose include brownish discoloration to irregular patches of discoloration bordered by veins. Spore masses of fungus can sometimes be found in lower leaf surfaces along veins during extended moist conditions (Stephen et al., 2002). The disease most often develops during the warm, humid weather. The infection process takes place rapidly when warm wet weather condition prevail (Research and Extension, 2011). The disease is usually seed-borne (Saifulla and Ranganathaiah, 1990; 1999) hence control of the disease could be achieved traditionally by

rotational cropping and use of cultivars and hybrids that are resistant to infection (Marley et al., 2002). Alternatively, sorghum leaf anthracnose can be controlled by the use of seed treatment fungicides (Gwary et al., 2002). Typical of these herbicide is the glyphosate. Glyphosate is a widely used broad-spectrum herbicide. However, the efficacy of these herbicides on pathogenic fungi produces many contradicting results.

The aim of this work is to evaluate the bio-efficacy of different concentrations of two herbicides; glyphosate and butachlor, on the growth and sporulation of *Colletotrichum graminicola* isolate in-vitro.

MATERIAL AND METHODS

Leaves of sorghum showing characteristic features of anthracnose disease were collected in polythene leather and taken directly to the laboratory. Using sterilized brush, the spores of the fungus on the leaf surfaces were scraped and dropped on SDA plate amended with gentamycin as recommended by Kutama et al. (2007) and later incubated at temperature of $27 \pm 2^\circ\text{C}$ for 7 days. Observation of germination and growth of the inoculum was done every day. After 7 days, the same procedure was followed to prepare another media in order to obtain a pure culture. Identification of the pathogen was done microscopically at X20 and X40 magnifications. Three different concentrations of each herbicide were made as; 20%, 50% and 80% of glyphosate and butachlor according to Mathure et al. (2001).

After all the three different concentrations were prepared, 5ml of each concentration of each herbicide was taken using a sterilized syringe and dispensed on a separate SDA- plate containing the fungal isolate (*C. graminicola*) and incubated for 7 days at $27\pm 2^{\circ}\text{C}$. A check was provided by amending the SDA with distilled water. Each treatment was replicated three times and laid out in completely randomized design. Observation on germination and mycelium growth as well as data collection were made daily for 7 days. This experiment was repeated three times and the mean data was obtained. Thread and ruler were used to measure the length of each fungal mycelium after the application of herbicide and then the mean value was calculated. Analysis of variance (ANOVA) was used to analyze the data and the means were separated using LSD.

RESULTS AND DISCUSSION

The *in-vitro* effects of butachlor and glyphosate on the germination % of *C. graminicola* is shown in Table 1. The results indicate that both butachlor and glyphosate inhibited the germination of the fungal isolate at 50% and 80% concentrations with significant difference ($P < 0.05$) as compared with control. This result agrees with that of Motpkhaye (1983) who studied the efficacy of some herbicides against germination of *C. graminicola* in the laboratory and demonstrated that the best results were given by butachlor and glyphosate. Gale (2002) found that, sorghum seeds when treated with butachlor prior to sowing and then sprayed with either glyphosate or butachlor herbicides six times; it reduced the infection of *C. graminicola*. Jhamaria and Sharma (2002) reported that glyphosate was the best treatment in minimizing the disease severity of *Rhizoctonia solani* Kühn, causing blight.

Earlier on, Leonard (1974) reported that an unimportant pathogen (*Colletotrichum graminicola*) considered as minor disease at that period was found to be the most damaging pathogen observed on corn in North Carolina in 1972 and 1973. Lodging and premature death of plants from the top caused by *C. graminicola* was considered most common in the coastal plain. Mbwaga et al. (1993) carried out a survey between 1986 and 1990 crop season which indicated that diseases viz; grain moulds, grey leaf spot (*Cercospora sorghi*), anthracnose (*Colletotrichum graminicola*), rust (*Puccinia purpurea*), leaf blight (*Excerohilum turcicum*), ladder leaf spot (*Cercosporatus imaculans*), sooty stripe (*Ramulispora sorghi*) and zonate leaf spot (*Gleocercospora sorghi*) of sorghum were in high frequency. Mathuret et al. (2001) conducted a field survey in rainy season of 1994 where a popular commercial sorghum hybrid CSH-9 was showing anthracnose (*C. graminicola*) symptom in several farmers' fields in Maharashtra state of India. Marley et al. (2002) conducted a field survey in

some states of northern Nigeria, throughout the sorghum (*Sorghum bicolor*) growing regions to identify the constraints against sorghum production in Nigeria. They found sorghum anthracnose as a major disease of sorghum in the region. Ngugi et al. (2002) conducted a two year survey (July, 1995 and 1996) to assess the prevalence and severity of sorghum anthracnose, in 91 and 109 farmer's field, respectively. Fourteen foliar and six panicle diseases were observed, with limited variation in disease prevalence and severity between the 2 years. The most common foliar disease observed was anthracnose with prevalence ranging from 44-65%. Recently, Kutama et al. (2010 a and b) conducted a survey in the Sudan savanna region of Nigeria and found sorghum anthracnose in almost 60% of the fields surveyed in 2008 and 2009 and therefore concluded that the disease was very prevalent.

Recent researches have shown that anthracnose of sorghum and many cereal crops caused by *Colletotrichum graminicola* is completely eradicated by the use of systemic seed treatment fungicides such as metalaxyl, carboxin and thiabendazole. Similarly, systemic herbicides have been indicated in the control of some seed-borne pathogenic fungi in the soil especially when applied before seeding (Gale, 2002; Stephen et al., 2002).

Similarly, the mycelium growth and sporulation of the fungal isolate was significantly different ($P < 0.05$) among the various concentrations of the two herbicides. Similar trend was observed in the inhibition of mycelium growth by 50% and 80% concentrations of the two herbicides. The mechanism by which these herbicides works is not very clear. Earlier on, Davidse (1986) reported that butachlor induced nuclear instability by disturbing the mitosis and meiosis process. Griffith (1981) also demonstrated that chemical agents involved in iatrogenic diseases influences the disease by affecting the host plant, the pathogen or the ecosystem. The various concentrations of the herbicides significantly inhibited mycelial growth was compared with the control. However, butachlor and glyphosate at 50% had the greatest inhibitory effect. The results of earlier works and the present studies indicated that the herbicides are highly effective in reducing the growth of the fungus. Laboratory studies confirmed earlier observations that glyphosate has activity against *Colletotrichum graminicola*. The results showed that glyphosate at rates between 0.84 and 1.68 kg/ha delayed the onset of the pathogen (Stephen et al., 2002).

Conversely however, several workers had earlier demonstrated the promotory activities of certain herbicides like metolachlor (an acetanilide herbicides) to increase the incidence of certain diseases such as downy mildew in sorghum, (Devlin et al., 1983; Frederiksen, 1980) even though, it was non-systemic herbicides.

Table 1: Effect of different concentrations of Butachlor and Glyphosate on the germination % of *Colletotrichumgraminicolaspores* seven days after incubation.

Concentration of Herbicide (%)	Germination % of <i>Colletotrichumgraminicola</i> seven days after incubation in:	
	Butachlor	Glyphosate
20	50.3	53.2
50	23.5	24.2
80	16.2	20.1
0 (water+SDA)	83.9	87.1
Mean	43.48	46.15
LSD(0.05)	1.73	1.65

Table 2: Effect of different concentrations of Butachlor and Glyphosate on the mycelia growth (sporulation) of *Colletotrichumgraminicolaspores* seven days after incubation

Concentration of Herbicide (%)	Mycelium length (cm) of <i>Colletotrichumgraminicola</i> seven days after incubation in:	
	Butachlor	Glyphosate
20	4.43	2.15
50	1.81	1.21
80	1.93	2.47
0 (water+ SDA)	6.02	5.00
Mean	3.55	2.70
LSD(0.05)	2.93	2.34

CONCLUSION

The results of the experiment have shown that both butachlor and glyphosate herbicides possess the bio-efficacy of inhibiting the growth of *C. graminicola* in-vitro at 50% and 80% hence can be used to control / prevent sorghum leaf anthracnose.

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Recommendations

Based on the results of the present study, further research is recommended on the exact dose of the two herbicides that can effectively control the disease in the field

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