APPLICATION OF INSECTICIDE IN VARIOUS VOLUMES OF WATER AT STAGES OF SORGHUM DEVELOPMENT FOR CONTROL OF FALL ARMYWORM (LEPIDOPTERA: NOCTUIDAE)

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RESUMEN

Una debilidad en las aplicaciones de insecticidas para el control de plagas del sorgo, es el desconocimiento existente acerca del efecto de los volúmenes de agua sobre la efectividad del producto químico aplicado. El objetivo de esta investigación fue determinar el efecto de diferentes volúmenes de agua aplicados en diferentes etapas fonológicas del cultivo sobre la efectividad de *clorpirifos* sobre el gusano cogollero (*Spodoptera frugiperda* (J. E. Smith) (Insecta: Lepidoptera: Noctuidae)) . El ensayo se estableció el 20 de Septiembre de 2001, en terrenos de la estación experimental numero 2 del Centro Nacional de Tecnología Agropecuaria y Forestal (CENTA), ubicado en San Andrés, departamento de la Libertad, El Salvador.. Se efectuaron aplicaciones de *chlorpyrifos* en dosis de 1.4 l ha^{-1} utilizando 285 y 142 litros de agua, aplicado en dos etapas de crecimiento del cultivo de sorgo (25 y 45 días después de siembra). Los tratamientos incluyeron una aplicación a un determinado volumen y tiempo (25 días después de siembra), y dos a aplicaciones a determinados volúmenes y tiempo, una a los 25 y otra a los 45 días después de siembra. La aplicación de Chlorpyrifos redujo de significativamente la infestación de larvas a las 24 horas después de la primera aplicación, cuando se le compara con el tratamiento control. Sin embargo, no se determinaron diferencias significativas en la eficacia del insecticida, cuando se comparó la infestación de larvas en parcelas tratadas con diferentes cantidades de agua. El volumen mayor de agua pareciera que mejora la distribución del producto químico sobre la planta, lo que conduce a una mayor mortalidad de larvas. Una segunda aplicación de insecticida, 20 días después de la primera aplicación, redujo significativamente la infestación de larvas comparada con una sola aplicación. Esta información indica que el incremento en los volúmenes de agua mejora la eficacia del insecticida Chlorpyrifos contra el gusano cogollero en el cultivo de sorgo. Una segunda aplicación del tratamiento insecticida es efectiva contra reinfestaciones de larvas y sugiere que el cogollero que se alimenta de estructuras vegetativas del sorgo, en los niveles encontrados en este estudio en el Salvador, puede reducir la producción de grano del sorgo.

ABSTRACT

A study was conducted to evaluate the effectiveness of an insecticide applied in different volumes of water at different stages of sorghum plant development for control of fall armyworm, *Spodoptera frugiperda* (J.E. Smith), larvae at San Andres, El Salvador in 2001. Chlorpyrifos at 1.4 l/ha in 142 or 285 l of water/ha was applied to sorghum at two stages of plant development (25 and 45 day-old plants). Treatments included one application at designated volume and time, (25 day-old plants) or two applications at designated volume and times, one on 25 and a second on 45 day-old plants. Chlorpyrifos treatments significantly reduced larval infestation 24 hours after the first application when compared with the untreated. However, no significant differences in insecticide efficacy were observed when comparing larval infestations in plots treated with different amounts of water carrier for the insecticide. The greater volume of water did appear to improve the distribution of the chemical on the plants to provide greater larval mortality. A second insecticide spray application 20 days after the first application significantly reduced larval infestations compared with only one application. This information indicates that increased volume of water improves chlorpyrifos insecticide efficacy against fall armyworm on sorghum, that a second insecticide spray treatment is effective against reestablished larval infestations, and suggest that fall armyworm feeding on vegetative sorghum at levels encountered in this study in El Salvador can reduce sorghum grain yield.

The fall armyworm, *Spodoptera frugiperda* (J. E. Smith), is distributed in Central and South America from Mexico to Argentina and Chile (King, 1980). The insect is considered to be one of the most important pests of sorghum in Latin America (King and Saunders, 1984; Paul, 1990) and can be a limiting factor in sorghum production in the tropics (ICRISAT, 1983). The larvae feed voraciously on leaves, tassels and grain.

Control of fall armyworm larvae can be best achieved when they are in early stages of development and becomes more difficult when they are larger and move down in the whorl of the plant (ICRISAT, 1983). Insecticide must be applied in a manner that ensures that the larvae will come in contact with the chemical to achieve consistent control (King and Saunders, 1984). The most common chemical application method used by farmers in El Salvador for control of fall armyworm involves using insecticide diluted in water, the medium in which the insecticide is suspended. There is a large number of chemical insecticides and many formulations of the materials available on the market for control of specific insects that attack and damage sorghum. Most of the insecticides can be applied using backpack sprayers. Often, farmers apply the insecticide using more than 250 liters of water per hectare. The total volume of liquid at application can be regulated with adjustments of the sprayer nozzle and regulating pump pressure. However, there is need to determine the effectiveness of the chemical application when administered in various volumes of water.

The objective of this research was to determine the effectiveness of a chemical insecticide applied in various volumes of water at two stages of sorghum development for control of fall armyworm.

METHODS AND MATERIALS

This study was conducted in an established sorghum [RCV variety, (M-35585 x CS 3541 Crosses 31) BK-5-2-2-3-1-1-1-BK] field at the National Center for Agriculture and Forestry Technologies Experiment Station Number 2 located in the San Andres Valley, Department of La Libertad in El Salvador, Central America. Test plots were established in a randomized complete block with 5 treatments and 4 replications. Each treatment plot consisted of 8 rows, 15 meters long, with 0.7 meters between rows. Treatments and replications were separated by 1.5 meters. Treatments included chlorpyrifos insecticide (1.4 l/ha) applied in the following programs: T1. one application using 285 liters (l) water/hectare (ha) 25 days after planting, T2. two applications using 285 l water/ha one 25 and a second 45 days after planting, T3. one application using 142 l water/ha 25 days after planting, T4. two applications using 142 l water/ha, one 25 and a second 45 days after planting, and T5. untreated. Insecticide sprays were made in the morning by the same person on each date to maintain uniformity of treatment application.

Observations were made before the first and second applications to determine the level of insect infestation in treatment plots. Plants with fresh foliage damage were marked to be identified for sampling 24 hours after application of the insecticide. To determine the effectiveness of the chlorpyrifos treatments, data collected for numbers of live and dead fall armyworm larvae after application of the insecticide were used to calculate percent larval survival. One hundred plants were observed in each plot at each sampling interval. The sampling consisted of whole plant destructive samples of marked plants. Yield was determined at harvest (13% seed moisture) from 14 meters of the two center rows in each treatment plot. Plants were harvested by hand (clipped panicles), and seed were thrashed in plastic bags and weighed on an electric scale in the laboratory. The data were analyzed using Analysis of Variance, F test and means were compared using Tukey's test at P=0.01 significance level.

RESULTS AND DISCUSSION

Insecticide treatment plots had significantly less live larvae than the untreated 24 hours after the first application of chlorpyrifos insecticide on 26 day-old plants (Table 1). Although no significant differences were obtained when comparing the 142 versus 285 liter water per hectare treatments, numerically fewer larvae survived in plots receiving the higher volume of water carrier. This suggests that the increased volume of water improved distribution of the chemical toxicant on the plants to provide for a greater level of insect mortality.

The level of larval survival following the second insecticide spray application 20 days after the first spray application was significantly lower in plots receiving this treatment program than in plots receiving only one spray application (Table 1). Observations in the field indicated that the fall armyworm continued to reinfest the sorghum following the first spray application. Infestations after the 45 day treatment indicated that plots receiving one spray application had 56.0 to 80.0% larval infestations, plots with two applications had 7.0 to 13.3% larval infestations, and the untreated plots had 95.5% infestation. These data further indicates the relative increase in efficacy of the insecticide for control of fall armyworm larvae on sorghum when the insecticide is applied in a greater volume of liquid carrier and when the first insecticide application is followed by a second insecticide application.

Sorghum grain yields from insecticide treatment plots were significantly greater than that from the untreated plots. No differences were observed among insecticide treatment programs. The information obtained in this study indicates chlorpyrifos insecticide efficacy on fall armyworm larvae, improved efficacy with increased volume of water used at application and with two spray treatments compared with one spray treatment, and further suggests that fall armyworm feeding on vegetative sorghum at levels encountered in this study in El Salvador can reduce sorghum grain yield.

Table 1. Percent survival of fall armyworm larvae 24 hours after application of chlorpyrifos insecticide on 25 and 45 day-old sorghum. San Andres, El Salvador, C.A. 2001.

Treatment (T)[1/]		Percent survival 24 hours after application on sorghum at different ages	
Number (Tn)	Water (l/ha)	25 days	45 days
T2	285	7.0 a [2/]	7.0 a
T1	285	8.0 a	56.0 b
T3	142	17.3 a	80.8 bc
T4	142	17.8 a	13.3 a
T5[3/]	0	95.3 b	95.5 c

[1/] Insecticide applied on day 25 only (T1 & T3) or days 25 and 45 (T2 & T4) after plant emergence.
[2/] Treatment means with the same letter are not significantly different (Tukey's test, P= 0.01).
[3/] Untreated (no insecticide).

Table 2. Sorghum yield from plots treated with chlorpyrifos insecticide applied in different volumes of water. San Andres, El Salvador, C.A. 2001.

Treatment (T)[1/]		Yield (kg/ha)
Number (Tn)	Water (l/ha)	
T3	142	5,017 a[2/]
T4	142	4,619 a
T1	285	4,605 a
T2	285	4,438 a
T5[3/]	0	3,574 b

[1/] Insecticide applied on day 25 only (T1 & T3) or days 25 and 45 (T2 & T4) after plant emergence
[2/] Treatment means with the same letter are not significantly different (Tukey's test, P=0.01).
[3/] Untreated (no insecticide).

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