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Effect of Lindane in Controlling the Sorghum Stem Borer, *Chilo partellus* (Swinhoe) and Their Persistence in Sorghum

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In sorghum, whorl application of Lindane 6 G on 25th DAS recorded the least stem borer damage. Whorl application of Lindane 6 G 0.37 kg ai./ha on 25th day + 0 45 kg ai /ha on 35th day (or) Lindane 6 G 0.45 kg ai/ha on 25th day + 0.45 kg ai./ha on 35th day registered less leaf injury, dead hearts, percentage of tunnelling and higher yield. There was a continuous absorption of lindane by sorghum plant upto 15 days following the treatment. The presence of lindane residues in grains in thsee treatments clearly indicates that lindane gets translocated from the treated sorghum plants to grains, which ranged from 0.40 to 0.77 ppm in grain, from 0.65 to 1.04 ppm in straw and these residues were less than the tolerance limit of 3 ppm.

The sorghum stem borer, *Chilo partellus* Swinhoe is one of the important pests of sorghum; its damage sometimes resulting in total crop failure (Butani, 1961). A schedule involving 3 75 kg ai. per ha Gamma HCH (Lindana) in three granular application in leaf whorls has been recommended by All India Coordinated Sorghum Improvement Project for an effective control of sorghum stem borer (Kathpal *et al.*, 1976 b). The extent of HCH residue in plants and grains in sorghum variety 'Swarna' as a result of above schedule was found to be high (Kathpal *et al*). Hence, experiment was conducted to determine the relative efficacy of granules of lindane in controlling the stem borer with minimum number of applications and to study the persistence and translocation of lindane residues in sorghum grain and straw.

MATERIAL AND METHODS

An experiment was conducted during summer 1980 at Coimbatore with five treatments, replicated four times in a RBD. Sorghum variety Co. 23 was sown with the spacing of 45 X 15 cm. The net plot size was 10 m^2. The treatments consisted of the whorl application of lindane 6G 0.37 kg ai./ha on 25th day and 0.45 kg ai./ha on 35th day after sowing (DAS); lindane 6 G 0.45 kg ai./ha on 25th day and 0.45 kg ai./ha on 35th DAS; lindane 6G 0.74 kg ai./ha on 25th day alone; lindane 6G 0.74 kg ai./ha on 35th day alone and untreated control.

Assessment of stem borer incidence was made when the plants were 35 days old by counting the total number of plants, number of plants with leaf injury and dead hearts/

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plot. The total and number of plants exhibiting deadhearts were recorded when the plants were 47 days old. At harvest, percentage of tunnelling was calculated by measuring the total length and tunnelled length by stemborer from ten plants selected at random per plot and percentage of incidence was worked out. Yield data for both grains and straw were also gathered at harvest.

To determine the lindane residues, plant samples were collected one day and 15 days after the final application and at harvest. The grain and straw samples were also collected at harvest.

Plant samples were chopped into small pieces and a representative of 50 g material in each case were extracted by blending with 150 ml of carbon tetrachloride and isopropyl alcohol mixture (2:1) (Kathpal *et al.*, 1976). The extract was then washed thrice with about 40–50ml of 2 per cent sodium sulphate solution to remove isopropyl alcohol and dried with anhydrous sodium sulphate. The grain samples were ground and 50 g representative flour was extracted with 300 ml of carbon tetrachloride in Soxhlet apparatus for 6 to 8 hrs. The extract was made-up to a known volume.

A suitable aliquot was taken from the extract and the estimation of lindane was carried out by the colorimetric method developed by Schechter and Hornstein (1952) with modifications suggested by the BHC panel (1962) and AOAC (1965).

RESULTS AND DISCUSSION

Plots treated on 25th day alone recorded almost same level of leaf injury (1.16% to 3.43%), whereas those which received protection on 35th day alone and no treatment showed higher percent of leaf injury (5.44 to 5.55%) on 30th day, thus emphasising the protection afforded during 25th day of the crop was responsible for lower leaf injury and it was the stage of the crop that stem borer usually makes entry into the plant.

The incidence of dead heart ranged from 3.28 to 5.35 per cent on 35th day and 3.05 to 5.64 per cent on 47th day in the protected plots, while it was 10.61 per cent on 35th day and 11.47 per cent on 47th day in unprotected plot. Those plots received two applications (25th and 35th day stage) recorded minimum dead heart incidence which those with one application (25th or 35th day stage) recorded a little higher range of dead heart incidence indicating the need to commence protection against stem borer on 25th day itself. Ahmed (1969) stated that one application of any insecticide did not give significant control, where as two or three applications with an interval of 10 days significantly reduced the dead hearts as compared to no treatment.

The percentage of stem tunnelled was maximum at 0.74 kg ai./ha applied on 35th day treatment to the level of 31.50, whereas in control it was 42.81 (Table I). The plots received two applications and one application on 35th day alone registered minimum per cent of tunnel damage. This might be due to the fact that 25th day alone treatment could have afforded protection for a shorter period at the early stage of the crop growth. The tunnel damage was found to range from 27.32 to 33 8 per cent in protected plots as against 42.81 per cent in untreated plots. Jotwani and Srivastava (1968) indicated that the infestation of sorghum stem borer at the time of earhead formation did not affect the yield of grain significantly.

The yield of grain and straw were 2400 and 9788 kg/ha, respectively for the plots which were not protected against stem borer, while the plots treated with 0.37 kg ai./ha applied on 25th day + 0.45 kg ai./ha applied on 35th day and 0.45 kg ai./ha applied on 25th day + 0.45 kg ai./ha applied on 35th day treatments recorded 3788.5 to 4212.5 kg/ha of grain and 11912 to 12083 kg/ha of the straw. When the crop was protected with 0.74 kg ai./ha applied on 25th day and 0.74 kg ai./ha applied on 35th day had given 3125 and 3475 kg/ha of grain and 11125 and 11963 kg of straw per ha respectively. The tunnel length damage which ranged from 27.3 to 46.2 per cent might have contributed for the major reduction in straw yield. This range in yield and consequent losses were attributed to the difference in protection against stem borer at various stages of the crop growth.

Translocation of lindane in sorghum plant

The average lindane residues translocated in plants one day after final application varied from 0.33 to 1 02 ppm, whereas the amount absorbed in plants 15 days after final application ranged from 0.92 to 1.37 ppm. The final residues in straw at harvest time varied from 0.86 to 1.15 ppm (Table II).

There was a continuous absorption of lindane by the surface of the plant upto 15 days following treatments, thereafter, the residues gradually declined. The decline in the content of the insecticide in plant parts may be due to dilution caused by increase in total foliage and degradation of the applied chemical on the plant. Earlier workers (San Antonio, 1959, in Carrots; Bradbury and Whitake, 1956, Lichtenstein *et al.*, 1967 in pea plant; Pathak *et al.*, 1971 in rice, Yadav 1976 in maize, carrots; radish and beetroot) have reported the translocation of HCH in various plant parts.

The waxy coating on the stalks of sorghum plants can possibly be a factor contributing towards translocation of lindane in sorghum (Katlipal *et al*, 1976). Lee (1965) showed that

the amount of lindane translocated through the root system was generally low and the mode of entry was through penetration into the straw by direct contact or movement into leaf sheath by capillary action. Ishii and Hirano (1962) confirmed this observation of Lee (1965) by using labelled lindane. The presence of lindane residues in grains at all treatments clearly indicates the translocation of lindane from the treated sorghum plants to grain. The lindane residues present in grain varied from 0 40 to 0 77 ppm. Kathpal *et al.*, (1976a, 1976b) reported translocation of HCH (mixture of all isomers) into sorghum grains

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TABLE I Effect of Lindane in the Control of Stem Borer and on the Yield of Sorghum

Treatment	Percent leaf injury on 35th day	Percent dead heart damage		Percent tunnel length	Yield in kg/ha	
		35th day	47th day		Grain	Straw
Lindane GG 6.25 kg/ha (0.35 kg ai./ha) applied on 25th day and 7.5 kg/ha (0.45kg ai./ha) applied on 35th day	3.43 (10.62)	5.35 (13.40)	4.71 (12.56)	33.79 (35.53)	3788.5	12.088
Lindane 6 G 7.5 kg/ha (0.45 kg ai./ha) applied on 25th day and 7.5 kg/ha (0.45 kg ai./ha) applied on 35th day	3.35 (10.48)	4.88 (12.64)	3.05 (9.96)	29.63 (32.88)	4212.5	11.912
Lindane 6 G 12.5 kg/ha (0.74 kg ai./ha) applied on 25th day alone	1.16 (5.59)	3.28 (10.19)	5.64 (13.53)	35.54 (36.59)	3125.0	11,125
Lindane 6 G 12.5 kg/ha (0.74 kg ai/ha) applied on 35th day alone	5.44 (13.46)	10.85 (19.17)	3.44 (10.51)	27.32 (31.50)	3475.0	11,963
No treatment	5.55 (13.64)	10.61 (18.99)	11.47 (19.78)	46.20 (42.81)	2400.0	9,788
CD (P = 0.05)	2.58	3.07	2.79	5.09	0.42	1.02

(Figures in parentheses indicate transformed values)

TABLE II Average of Lindane Residues in Sorghum (PPM)

Treatments	One day after final application (plant)	15 days after final application (plant)	60 days after final application (sorghum straw)	60 days after final application (sorghum straw)
Lindane 6 G 6.25 kg/ha (0.37 kg ai./ha) applied on 25th day and 7.5 kg/ha (0.45 kg ai./ha) applied on 35th day	0.87	1.22	0.86	0.56
Lindane 6 G 7.5 kg/ha (0.45 kg ai./ha) applied on 25th day and 7.5 kg/ha (0.45 kg ai/ha) applied on 35th day	1.02	1.41	0.89	0.68
Lindane 6 G 12.5 kg/ha (0.74 kg ai./ha) applied on 35th day alone	1.01	1.06	0.65	0.40
Lindane 6 G 12.5 kg/ha (0.74 kg ai./ha) applied on 35th day alone	0.33	1.30	1.04	0.77

Meteorological data during experimental period

Total rainfall (mm)	:	58.3
Range of maximum temperature (° C)	:	31.6 — 35.7
Range of minimum temperature (° C)	:	16.5 — 23.6
Range of relative humidity (%)	:	75.2 — 86.3