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Evaluation of carbon dioxide treatment on the management of groundnut seed borer (*Caryedon serratus*)

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ABSTRACT

A study was conducted to evaluate the efficacy of carbon dioxide (CO_2) treatment against the groundnut seed borer [*Caryedon serratus* (Fabricius)]. Four concentrations of CO_2, viz. 0 (untreated), 30, 40 and 50%, were evaluated against insect infestation as well as seed viability. Ten pairs of *C. serratus* were released in one litre glass container containing 125 g groundnut (*Arachis hypogaea* L.) pods. Carbon dioxide was injected into the container by flushing method. Observations were recorded on per cent insect infestation, germination and moisture during the third and sixth month after treatment. The insect infestation was 2.5 and 4.2% in untreated seeds during third and sixth month, respectively. In 30 and 40% CO_2 treatments, very minimum infestation (<0.5 %) was observed, whereas infestation was nil in 50% CO_2 treatment. The germination of CO_2 treated seeds was between 72.0 and 74.0% and m.c. was between 7.2 and 7.3%. Thus, CO_2 can be a good alternative to use of chemical treatments including fumigants for preventing *C. serratus* infestation in groundnut.

Key words: *C. serratus,* Groundnut, Insect infestation, Seed viability

Groundnut (*Arachis hypogaea* L.) is being stored both as unshelled pods and as kernels. More than 100 species of insects are found associated with stored groundnut, but only a few species cause economic damage. *Caryedon serratus* (Fabricius) (Bruchidae: Coleoptera) is the only major insect pest of groundnut that damages unshelled nuts and it takes about 60 days to complete its life cycle under optimum conditions (Ranga Rao et al., 2010). Usage of chemical insecticides and fumigants to contain stored product pests in food grain storage resulted in problems, i.e. handling hazards, residues, selection of resistant insects to chemicals, resurgence and environmental pollution (Bailey and Banks, 1980; Annis, 1987). Further, in case of chemical fumigants, immature stages of insect pests are showing tolerance. Carbon dioxide (CO_2) could be a good alternative to chemicals in combating stored product pests, since it is effective, safe and environment friendly (Shazali et al., 2004). Effectiveness of CO_2 was tested against various stored product pests, viz. *Tribolium castaneum* (Herbst), *Tribolium confusum* du Val and *Plodia interpunctella* (Hubner) (Ali Niaze and Lindgren, 1970; Lum and Flaherty, 1972); *Sitophilus oryzae* (L.) (Annis and Morton, 1997); *Stegobium paniceum* (L.) and *Lasioderma serricorne* (Fabricius) (Gunasekaran and Rajendiran, 2005) and *Rhyzopertha dominica* (Fabricius) and *Corcyra cephalonica* (Stainton) (Bera et al., 2004). This study was undertaken to evaluate the effectiveness of CO_2 against groundnut borer, *C. serratus.*

MATERIALS AND METHODS

The study was conducted at the Seed Centre, Tamil Nadu Agricultural University, Coimbatore from August 2015 to February 2016. Unshelled groundnut was used as the medium for culturing *C. serratus*. Room temperature of 27±2°C and 70±5% r.h was maintained at the culture room. For getting uniform aged adults, 250 g of fresh unshelled groundnut pods was exposed to 20 pairs of insects and allowed for one to two days for oviposition. All the adult insects

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Table 1 Effect of carbon dioxide (CO_2) treatment on *C. serratus* infestation and germination in groundnut

Treatment	Germination (%)		Moisture (%)		Insect infestation#	
	3rd month	6th month	3rd month	6th month	3rd month	6th month
T_1, Normal air treatment	73.0* (58.47)	72.0 (57.83)	8.7 (17.25)	7.2 (15.59)	2.53 (9.15)	4.2
T_2, CO_2 @ 30% of the volume	73.0 (58.90)	73.0 (58.47)	8.8 (17.25)	7.3 (15.70)	0.03 (1.03)	0.02
T_3, CO_2 @ 40% of the volume	74.0 (59.12)	73.0 (58.47)	8.8 (17.25)	7.3 (15.67)	0.01 (2.23)	0.02
T_4, CO_2 @ 50% of the volume	73.0 (58.47)	74.0 (59.12)	8.7 (17.11)	7.2 (15.59)	0.0 (2.86)	0.0
SEd	0.30	0.30	0.076	0.14	0.49	0.06
CD (P = 0.05)	0.70	0.69	0.17	0.34	1.14	0.14

*Mean of three replications; # percent weight loss Initial germination, 79%; initial m.c.: 9.0, values in the parentheses are arc sine transformed

were removed after 2 days and uniform aged adults were collected 55 days later on average.

Freshly harvested and untreated groundnut pods (variety 'TMV 3') with 79.0% germination and 9.0% m.c were used for the study. Groundnut pods (125 g) were taken in one litre glass container (fitted with rubber septa for injecting CO_2) and 10 pairs of freshly emerged *C. serratus* were released. Twenty days after insect release, 0 (untreated), 30, 40 and 50% volume of the bottles were filled with CO_2 by flushing method. The volume as well as concentration of CO_2 to be injected into the containers was arrived based on White et al. (1993) with modifications suggested by Sridhar (2007) and Srithar (2008).

Each treatment was replicated thrice and observations namely % insect infestation (weight loss), germination and moisture were recorded during third and sixth month. The count and weigh method was used to estimate weight loss and m.c. was determined by oven method. Volume of CO_2 present inside the container was check verified at frequent intervals by using CO_2 analyser (Model: Dansensor). The experiment was laid out by following completely randomized block design and analysed using TNAUSTAT (Manivannan, 2014).

RESULTS AND DISCUSSION

In a controlled atmospheric storage, atmospheric gas concentration is maintained at a level lethal to insects throughout the storage period. Usually in controlled atmospheric treatment, atmospheric gases rich in CO_2 and low in O_2 or a combination of these two gases are maintained in a storage structure. In the present study, groundnut borer, *C. serratus* were exposed to four different CO_2 concentrations, viz. 0 (untreated), 30, 40 and 50% for a period of three and six months duration.

In untreated pods, 2.5 and 4.2% infestation was recorded during third and sixth month respectively. A minimum insect infestation (< 0.5%) was recorded in 30 and 40% CO_2 treatment, being nil in 50% CO_2 treatment during above mentioned two storage periods (Table 1). The result of this study is in contrary with the findings of Radhika et al. (2014), who reported no pod damage by *C. serratus* when groundnut was stored at 20, 30 and 40% CO_2 concentrations.

The results of this study are in line with the findings of Gunasekaran and Rajendiran (2005), who reported 65% CO_2 concentration was lethal to *S. paniceum* and *L. serricorne*. They also reported that changing CO_2 concentrations during storage of food grains causes more insect mortality than the constant CO_2 concentration. Elevated CO_2 levels may cause opening of spiracles in the insect body and insects die due to water loss (Mitcham et al., 2006). Mortality of C. *serratus* at 50% CO_2 treatment could be due to desiccation. Also, in the present study groundnut viability was not affected by the elevated CO_2 concentrations (Table 1). Jayas and Jeyamkondan (2002) reported that controlled atmospheric storage preserved grain viability, prevented mould growth and did not affect the chemical composition of stored grains.

CONCLUSION

Groundnut seed borer, *C. serratus* infestation during groundnut pod/kernel storage could be minimised by treating the pods/kernels with CO_2.

Groundnut pods treated with 30 and 40 per cent CO2, infestation was below 0.5 per cent, whereas in 50 per cent treatment no infestation was observed. Hence, instead of using chemical insecticides and fum, igants during storage, groundnut seeds could be treated with CO2 to prevent seed borer infestation.

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