RESEARCH ARTICLE

The Annals of Zoology
ISSN (Print): 0003-5009
Annals of Zoology, Vol. 30; December 2014, 40-45

Insecticidal Effects of Extract of *Piper nigrum*, *Capsicum annum* and *Lantana camara* on *Callosobruchus chinensis* in Chickpea Seeds

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ABSTRACT

Aqueous extracts of P. nigrum, C. annum and L. camara were tested for their efficacy against adults and F_1 emerged individuals of C. chinensisunder laboratory conditions of 30 ± 2^{0}C and 70 ± 5%. Among all the treatments P. nigrum was found to be the best in causing insect mortality. In present experiment complete mortality of adults was achieved in 7.03 days by P. nigrum, 7.10 days by C. annum and 7.43 days by L. camaraas compared to 15.03 in control. As for mortality of F_1 emerged individuals, P.nigrum showed minimum days (9.03 days) followed by C. annum (9.36 days) and L. camara (10.03 days) at highest conc.

Key words: *Piper nigrum, Capsicum annum, Lantana camara, Callosobruchus chinensis, mortality, F_1 individuals*

INTRODUCTION

Cicer arietinum a member of the pea family Fabaceae, is one of the most important leguminous, cold-season, food crop, cultivated prevalently in the Asian Pacific region. Chickpea (*C. arietinum*) has two main commercial varieties, Desi and Kabuli (Mansfeld, 2008). It contains 38-59% carbohydrate and 25.3-28.9% protein. Besides this it is a very good source of Vitamin A. Folates and Essential micronutrients like copper, iron and zinc (Bender and Bender, 2005). India is the largest exporter of chickpea in the world, contributing to 30% of the total world exports. However, nearly 8.5% of the total annual production is lost during post harvest handling and storage (Agarwal *et al.,* 1988). In the past, infestation was often a less serious problem because farmers cultivated traditional varieties which though low yielding, were generally more resistant to attack by pests. However, the introduction of high yielding pulse varieties has resulted in increased storage losses since they are usually more susceptible to pest damage (Shazia, *et al.,* 2006). *Callosobruchus chinensis* (L.), the grain weevil or bruchid is byfar the most economically destructive and major pest of chick pea which attacks the grain in storage effecting it both qualitatively as well as quantitatively (Ahmed, *et al.,* 2003). Grubs make hole in the grains and consume the inner part leaving empty kernel. They severely damage the grain by causing overall weightloss, altered nutritional quality and presence of insect frass, excrement and dead insects in and on the seed, and loss of seed viability (Raja, *et al.*, 2008; Patel, 2011; Islam, *et al.,* 2013; Tesfu and Emana, 2013). The attack of *C. chinensis*is also associated with increase in some antinutritional factors like saponin, phytic acid and trypsin inhibitor activity and significant decrease in B complex vitamins making the grain unsuitable for human consumption (Modgil and Mehta, 1997). Gujar and Yadav (1978) reported 55-60% loss in seed weight and 45.50-66.30% loss in protein content due to its damage rendering the seeds unfit for human consumption as well as for planting. Severe infestation at times leads to 100% damage (Borikar and Puri, 1985) thus, effecting the economy of the country, warranting the need for suitable measures for their control. The use of plant materials as traditional protectants for stored grains was an old practice used all over the world (Golob and Webley, 1980) but with the advent of

synthetic and petro based pesticides after the Second World War this tradition was largely neglected by farmers. The enhanced economic potential of the pesticides in terms of increased food production and amelioration of vector borne diseases replaced the natural traditional protectants. The Pulse Beetle is an internal feeder. It is therefore hard to control it with insecticides. It is also not advisable to mix insecticides with food grains. Fumigation although quite effective cannot be practiced in our villages because the storage structures are not air tight and most of the storage types are open to reinfestation by insect pests (Tapondjou, *et al.,* 2002). In view of these problems together with the upcoming WTO regulations, there is a need to restrict their use globally and implement safe alternatives of conventional insecticides and fumigants to protect stored grains from insect infestation (Yusuf and Ho, 1992; Subramanyam and Hagstrum, 1995). Plant based insecticides, on the other hand are target specific, non-toxic to humans and beneficial organisms, less prone to insect resistance and resurgence, biodegradable and less expensive seem to be safe grain protectants.

MATERIAL AND METHODS

Mass Breeding and Rearing of the Insect:

The laboratory culture of *C. chinensis* was maintained throughout the year by rearing them under controlled laboratory conditions at the Department of Zoology, P.P.N. College, Kanpur, on a diet of chickpea grains, in pre-sterilized jars at a constant temperature of 30 ± 2^{0}C and 70 ± 5% relative humidity (Talekar, 1988).

Raising the Culture of *C. chinensis*:

For raising the culture of *C. chinensis*, a small population of the Pulse Beetle was obtained from Department of Entomology, CSA University of Agriculture and Technology, Kanpur. The male and female of the Pulse Beetlewere identified following the identifying characters of male and female as described by Halstead (1963). They were then reared in plastic/glass containers containing pre-sterilized chickpeas. This was done to maintain a continuous laboratory culture. During the course of investigation in order to obtain a homogenous population of test insect that did not show much variation in sensitivity within the population, 15 pairs of insects were picked up from the stock culture and transferred to glass/plastic jars. Jars were covered by a muslin cloth and secured tightly with rubber bands. After 24 hours all the adults were removed and egg laid grains were maintained at required temperature and humidity. Insects that emerged after four weeks were used. Insect eggs were counted with the help of hand lens.

Stored Chickpea Grains (*Cicerarietinum*):

Healthy and fresh chickpea grains were obtained from the local market after ensuring that they were free from pre storage infestation and eggs. The grains were thoroughly washed and dried to avoid the effect of any pesticide/insecticides before storing them in glass/plastic containers.

TEST MATERIALS

Botanicals:

Plant materials *viz., P.nigrum, C. annum* and *L. camara* were evaluated for their insecticidal potency against *C. chinensis* L. infesting stored chickpea grains. These plant materials were used in the form of water extracts as stored grain protectants.

Preparation of Water Extracts and Their Application:

In experimental trial, water extracts of above mentioned plant materials obtained by decoction method were used to assess their insecticidal impact. Twenty grams of each plant material in crushed form were added separately to 2.0 liters of water in a ceramic pot and boiled at 100^{0}C for 10 minutes. Metallic kettle was avoided for any possibility of reaction with herbs. The pot was kept covered to avoid evaporation that could lead to the

possibility of degrading the pesticidal effect of herbs. After cooling at room temperature, the water extract for every plant material was strained by a fine sieve and stored in a separate glass beaker. The water extract of each plant was used in three concentrations 0.5 ml, 1.0 ml and 2.0 ml per 100 gm of chickpea grains. They were measured in 0.5 ml, 1.0 ml and 2.0 ml (v/w) amount with the help of micro pipette and applied on sterilized cotton swabs. The treated cotton swabs were placed at bottom of each pre sterilized jar with 100 gm of thoroughly washed and dried chickpea grains. These grains were shade dried to minimize fungal infestation during experiment. Thereafter, 15 pairs of adult test insect were released in each jar. These treated jars were placed in incubator along with three untreated jars used as control to study various parameters as in case of plant powders.

PARAMETERS STUDIED USING PLANT EXTRACTS

Effect on Mortality of Adult and F_1 Pulse Beetle (Days to 100 per cent Mortality):

In each treated jar, days taken for cent percent mortality of released adults of pulse beetles were counted and compared with untreated jars (control) to find out the efficacy of all treatments on the longevity of pulse beetles.

Reduction percentage in longevity of adult pulse beetle was calculated by the given formula:

Percentage reduction in longevity of test insect-

$$= \left(\frac{L_c - L_t}{L_c}\right) \times 100$$

Here,

L_c = Average days taken for 100 per cent mortality of adult pulse beetle in control

L_t = Average days taken for 100 per cent mortality of adult pulse beetle in treated jars

STATISTICAL ANALYSIS

In the present work statistical analysis was done to analyse significance by 't' test (Chandrasekharan and Parthasarthy, 1975).

RESULTS AND DISCUSSION

Effect of Extracts of *P.nigrum*, *C. annum* and *L. camara* on the Days to 100 per cent Mortality of Test Insects:

All the three plant extracts at the applied concentration of 2.0, 1.0 and 0.5 ml per 100 ml of chickpea grains significantly reduced days to 100 per cent mortality of adult insect as compared to control (Table 1). Minimum days (7.03) to 100 per cent mortality were observed in *Piper nigrum* treatment at 2.0 ml concentration that was at par to 7.1 days taken by *Capsicum annum* at same concentration. *Lantana camara* showed minimum 7.43 days which was maximum among all treatments at this concentration. It was observed that a decrease in the concentration of plant extract increases the days to 100 per cent mortality of test insect proportionately. In present finding our all data were found significant and in higher concentration highly significant.

Effect on Days to 100 per cent Mortality of F_1 Individuals:

The data in Table 2 reveals that *Piper nigrum* showed the minimum time (9.03 days) to 100 per cent mortality of F_1 individuals at 2.0 ml concentration, *Capsicum annum* treatment required 9.36 days followed by *Lantana camara* (10.03 days) at the same concentration. All treatments were significant at 1.0 and 2.0 ml concentrations compared to the control that showed maximum (14.6) days to 100 per cent mortality of F_1 individuals. Effect shown by *Capsicum annum* was statistically similar with that of *Lantanacamara* at 0.5 ml concentration, showing 13.8 days to mortality of F_1 individuals of test insect.

Table 1: Effect of plant extracts of *P.nigrum*, *C. annum* and *L.camara* on days to 100% mortality of adult *C.chinensis.*

Plant Extracts		Days taken to 100% mortality of adult *C.chinensis*	Percentage of reduction in longevity of adults
		Mean with Standard deviation	
P.nigrum	0.5	11.16	25.74
	1.0	8.36**	44.37
	2.0	7.03**	53.22
C. annum	0.5	11.83*	21.29
	1.0	9.16**	39.45
	2.0	7.10**	52.76
L.camara	0.5	13.00	13.50
	1.0	9.03**	39.92
	2.0	7.43**	50.56
Control		15.03	--

-Table value of t at *df* 4 at P=0.05 is 2.78 and at P=0.01 is 4.60.

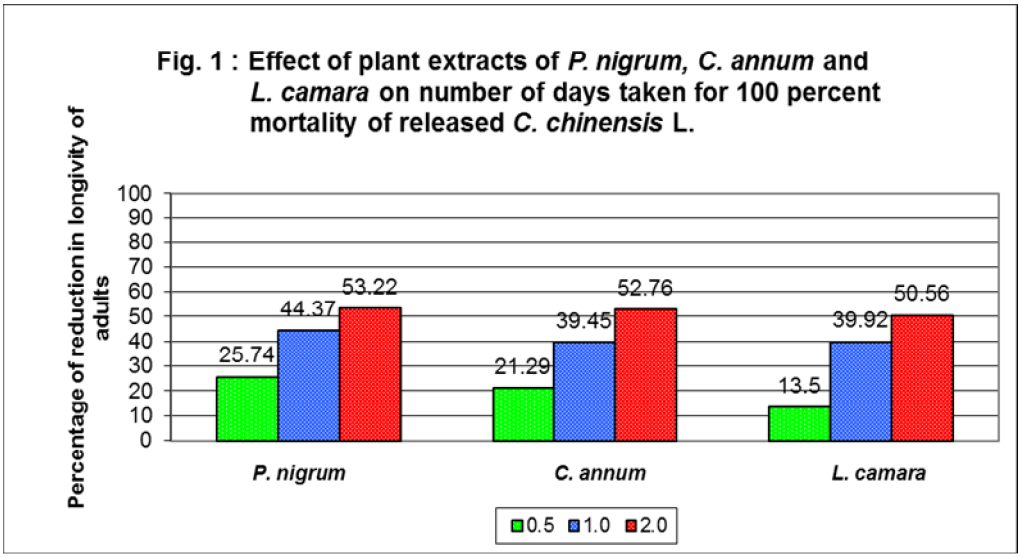

Fig. 1: clearly indicates that *P. nigrum, C. annum* and *L. camara* reduce more than 50 per cent longevity of adult pulse beetles over control when applied at their highest concentration.

Table 2: Effect of plant extracts of P.nigrum, C. annum and L.camara on days to 100% mortality of emerged F_1 individuals ofC.chinensisL.

Plant Extracts		Days taken to 100% mortality of emerged F_1 individuals of*C.chinensis*	Percentage of reduction in longevity of F_1 emerged
		Mean with Standard deviation	
P.nigrum	0.5	12.70	13.01
	1.0	10.03*	31.30
	2.0	9.03**	38.15
C. annum	0.5	13.83	5.27
	1.0	10.53*	27.87
	2.0	9.36**	35.89
L.camara	0.5	13.80	5.47
	1.0	10.83*	25.82
	2.0	10.03**	31.30
Control		14.60	--

- Table value of t at *df* 4 at P=0.05 is 2.78 and at P=0.01 is 4.60.

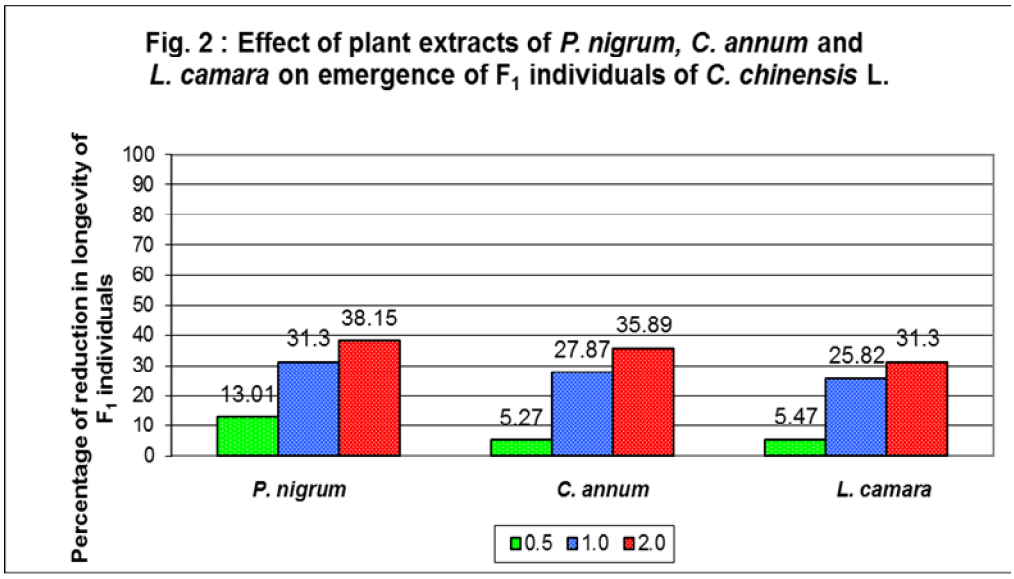

Fig. 2: Graphically represents percentage of reduction in longevity of F_1 individuals after treatment with *P. nigrum, C. annum* and *L. camara*. *P. nigrum* showed maximum reduction (38.15) followed by *C. annum* (35.89) at 2ml concentrations, while *L. camara* showed 31.30 per cent reduction at the same concentration

All the three plant extracts namely *P. nigrum*, *C. annum* and *L. camara*reduced longevity of *C. chinensis* adults (Table 1) and F_1 emerged adults (Table 2). Increase in the concentration of extracts was directly proportionate to reduction in longevity of test insect. *Piper nigrum* was most effective followed by *C. annum* and *L. camara*. However, all the treatments with higher concentration were significantly effective in comparison to control. A similar effect of *Piper* was observed by Khani and co-workers (2013) on *Corcyra cephalonica*. They evaluated methanol extract of *P. nigrum* and *Jatrophacurcas* for their toxicity and antifeedant activity resulting into mortality of test insect. Oparacke (2007) reported that *Piper guineense* extracts at 20 and 10 per cent concentration successfully reduced two major flowering pests namely *Marucavitarata* and *Clavigrallatomentoricollis* infestation. Oliver, 1959; Scott, *et al.,* 2008, 2007, 2004; Su 1977; Miyakado, *et al.,* 1980, 1979 suggested that *Piper* species contain Piperine, Caryophyllene, Limonene and Chavicine which are insecticidal to crop pests. Ponce de Leon (1983) investigated the insecticidal activity of black pepper and red pepper on major storage insect pests of corn and legume and found an insecticidal effect similar to that in the present investigation. The result showed that *C. chinensis* was more susceptible than *S. oryzae* and *T. castaneum.* Kiradoo and Srivastava 2011 potential of some other plant extracts *viz. Azadirachtaindica, Ocimumbasilicum, Ocimum sanctum* and *Menthaspicata* against *C. chinensis* and obtained similar mortality trends similar in the present work. Saxena, *et al.,* 1992 pointed out that aerial parts of *L. camara* used against *C. chinensis* in form of petroleum ether with methanol extracts caused 10-43% mortality at 1.5% concentration.

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