Research Paper :

Bioefficacy of botanicals material against *Callosobruchu chinensis* (Linnaeus) in stored chichpea

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SUMMARY

Different materials *viz.*, vegetable oils, powders of different plant materials and inert dust (ash) were tested for their efficacy against the pest, *Callosobruchus chinensis* (Linnaeus) during August to December, 2007. Treatment ash in chickpea seeds was found more effective up to 4 months and with neem oil up to 2 months on the basis of oviposition. Chickpea seeds treated with ash and neem oil were also found more effective on the basis of adult mortality and adult emergence up to 4 months and seed damage.

Key words : *Callosobruchus chinensis*, Chickpea, botanicals

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Pulses are important source of dietary protein, and have unique property of maintaining and restoring soil fertility through biological nitrogen fixation as well as conserving and improving physical properties of soil by virtue of their leaf fall. Pulse crops leave behind reasonable quantity of nitrogen in the soil and add up to 30 kg N/ha.

Chickpea is the most important pulse crop of India, and occupies 7.1 million hectare with a production of 5.75 million tonnes, accounting for 30.9 per cent and 39.9 per cent of total pulse area and production, respectively (Anonymous, 2006). In Gujarat, chickpea is cultivated in about 1,22,700 hectare area within annual production of 98,500 m tonnes with yield of 803 kg/ha (Anonymous, 2005).

Pulse beetles, *Callosobruchus* sp. is major pest during storage of chickpea. It causes heavy losses to the tune of 10 to 60 per cent (Gupta and Kashyap, 1971). Among five known species of *Callosobruchus* from India, three *viz.*, *Callosobruchus chinensis* (Linnaeus), *Callosobruchus maculatus* (Fabricius) and *Callosobruchus analis* (Fabricius) are the important pests of stored pulses (Raina, 1970).

Infestation starts right from the field and continues to the store, attains its peak in January and shows no incidence from February to July under field conditions. In stored conditions maximum damage is caused in months of July to September (Borikar and Pawar, 1994 and Butani *et al.*, 2001). Pulse beetle causes not only quantitative but also qualitative losses like nutritive loss, germination loss and makes the chickpea unfit for marketing as well as for human consumption (Kenghe and Karawade, 1996).

Many synthetic insecticides have been found effective against pulse beetle (Patil *et al.*, 1994 and Jolli *et al.*, 2005) but these are hazardous due to their residues in food. These adverse effects of insecticides need diversified efforts for evolving more convenient, safer and alternative methods to minimize the losses on chickpea. The botanical materials offer the potential for developing safe pesticides that can be used in integrated pest management strategies. The use of indigenous plant materials has acquired an important position in the modern approaches of pest control as they are comparatively safer to mammals due to their rapid biodegradable nature.

MATERIALS AND METHODS

A laboratory experiment was carried out to evaluate bioefficacy of different materials *viz.*, vegetable oils, powders of different plant materials and inert dust (ash) against the pest, during August to December, 2007. Plant materials were collected and dried under shade and powdered in the electric grinder and sieve through domestic sieve. The wooden ash was obtained from local hearth. Each treatment was

applied to 1 kg seeds of chickpea previously disinfected and conditioned, kept in 1.5 kg capacity plastic container, covered with lid and stored for 4 months in laboratory. Such three repetitions were taken. The treatments were evaluated based on oviposition deterrent, adult mortality and grain damage.

Experimental details:

- Design : Complete randomized design
- Number of repetitions : Three
- Name of treatments : Thirteen as under

Treatment	Common name	Botanical name	Concentration
T_1	Garlic powder	*Allium sativum*	1% w / w
T_2	Ginger rhizome powder	*Zingiber officinale*	1% w / w
T_3	Turmeric powder	*Curcuma longa*	1% w / w
T_4	Tulsi leaf powder	*Ocimum sanctum*	1% w / w
T_5	Neem leaf powder	*Azadirachta indica*	1% w / w
T_6	Sesame oil	*Sesamum indicum*	1% w / v
T_7	Castor oil	*Ricinus communis*	1% w / v
T_8	Mustard oil	*Brassica juncea*	1% w / v
T_9	Coconut oil	*Cocus nucifera*	1% w / v
T_{10}	Karan oil	*Pongamia pinnata*	1% w / v
T_{11}	Neem oil	*Azadirachta indica*	1% w / v
T_{12}	Ash	-	50 % w / w
T_{13}	Control	-	-

Bioefficacy of botanicals C. chinensis in stored chickpea :

Evaluation based on oviposition deterrent / interference effect :

After treatment application, three samples (one sample as one repetition) each of 100 g chickpea seeds were drawn treatment wise at monthly interval and placed in one litre cylindrical plastic transparent jar (20 x 15 cm) individually. Five pairs of adult (1 day old) were released for oviposition for 24 hours in each sample. The observations on number of eggs per 50 seeds were recorded after 1st, 2nd, 3rd and 4th month of treatment.

Evaluation based on adult mortality and adult emergence :

Three samples each of 100 g chickpea seeds were drawn from each treatment and kept in 1 litre cylindrical plastic transparent jar (20 x 15 cm). Five pair of adults of *C. chinensis* was released in every sample. All the adults live or dead were removed after 7 days of exposure period. The botanical material which gave 100% protection was again tested to verify the result. Adult mortality was recorded at 72 hours. The experiment was repeated at monthly interval and number of adult emergence at monthly interval was recorded.

Evaluation based on damage of chickpea seeds :

The damaged and healthy seeds were stored out in each repetition. One or more holes per seed were considered as damaged seed.

Observations on number of damaged and healthy seeds were recorded after 4 months. The per cent grain damage was worked out by following formula (Singh *et al.*, 2001):

$$\text{Per cent grain damage} = \frac{\text{No. of seeds with hole}}{\text{Total No. of seeds}} \times 100$$

RESULTS AND DISCUSSION

The use of plant materials with insecticidal properties is an attractive alternative for the synthetic pesticides. Therefore, eleven different botanicals as well as oils *viz.*, garlic powder, ginger rhizome powder, turmeric powder, tulsi leaf powder, neem leaf powder, sesameum oil, castor oil, mustard oil, coconut oil, karanj oil, neem oil @ 1 % w/ w or w/v and inert dust (ash) @ 50 % (w/w) were tested.

Evaluation based on ovipositional deterrent effect :

Number of eggs laid after 1 month :

The results presented in Table 1 indicated significant differences in number of eggs laid by *C. chinensis* on chickpea seeds treated with different botanicals and inert dust. Maximum protection (no eggs) was obtained when chickpea seeds were treated with neem oil (0.00) and ash (0.00). The treatment tulsi leaf powder (19.67 eggs/ 50 seeds) was found least effective. Kachare *et al.* (1994) and Raghvani (1998) also found similar results.

Number of eggs laid after 2 months :

The results presented in Table 1 indicated significant differences in number of eggs laid by *C. chinensis* on chickpea seeds treated with different botanicals and inert dust. Maximum protection (no eggs) was obtained when chickpea seeds were treated with neem oil and ash. The

treatment tulsi leaf powder (44.67 eggs/50 seeds) was found least effective.

Number of eggs laid after 3 months :

The results presented in Table 1 indicated significant differences in number of eggs laid by *C. chinensis* on chickpea seeds treated with different botanical materials and inert dust. Maximum protection (no eggs) was obtained when chickpea seeds were treated with ash, followed by seeds treated with neem oil (2.33 eggs/ 50 seeds). The treatment with turmeric powder (125eggs/50 seeds) was found least effective. Singh (2003) also found more or less similar result.

Number of eggs laid after 4 month :

The results presented in Table 1 also indicated significant differences in number of eggs laid by *C. chinensis* on chickpea seeds treated with different botanical materials and inert dust. Maximum protection (no eggs) was obtained when chickpea seeds were treated with ash. The treatment turmeric powder (172.83 eggs/50 seeds) was found least effective.

Evaluation based on adult mortality:

The results presented in Table 2 indicated significant differences in adult mortality of *C. chinensis* after 3 days of release in 100 g chickpea seeds treated with different botanicals and dust. The maximum protection was obtained when chickpea seeds were treated with neem oil (100 %) and ash (100 %) after 3 days of release. The treatment tulsi leaf powder (27.00%) was found least effective which was at par with the treatments mustard oil (29.00%) and Castor oil (29.67%). Meghval *et al.* (2005) also found more or less the similar results.

Evaluation based on adult emergence in chickpea seeds at monthly interval :

Number of C. chinensis adult emergence in 100 g chickpea seeds treated with different botanical materials and inert dust after 1 month :

The results presented in Table 2 indicated significant differences in number of *C. chinensis* adult emergence in chickpea seeds treated with different botanical materials and inert dust after 1 month. Maximum protection (no adult emergence) was obtained when chickpea seeds were treated with neem oil and ash. The treatment turmeric powder (12.67 adult/ 100 gm seeds) was found least effective which was at par with the treatment Tulsi leaf powder (11.64 adult/ 100 g seeds). These findings are in agreement with Khaire *et al.* (1992).

Table 1 : Effect of various botanical materials against *C. chinensis* for ovipositional deterrent property in stored chickpea at monthly interval

Treatment	Number of eggs laid per 50 grains after			
	1 month	2 month	3 month	4 month
Garlic powder	7.67 gh	16.33 g	54.67 f	81.67 g
Ginger rhizome powder	7.33 h	14.67 gh	24.04 g	48.00 h
Turmeric powder	13.33 cd	39.33 c	125.00 b	172.83 b
Tulsi leaf powder	19.67 b	44.67 b	88.67 c	157.00 c
Neem leaf powder	9.00 ef	14.00 h	26.33 g	46.67 h
Sesame oil	12.67 d	25.00 d	69.67 d	116.67 e
Castor oil	11.67 de	22.67 e	67.00 d	105.33 f
Mustard oil	14.33 c	26.33 d	71.00 d	128.67 d
Coconut oil	8.67 f	20.67 f	58.67 e	96.67 f
Karanj oil	4.00 i	12.33 i	21.33 h	43.33 h
Neem oil	0.00 j	0.00 j	2.33 ij	3.00 i
Ash	0.00 j	0.00 j	0.00 j	0.00 j
Control	27.33 a	81.33 a	170.33 a	210.67 a
S. E. ±	0.48	0.68	2.93	2.97
C. D. (P=0.05)	1.40	1.97	8.51	8.62
C. V. %	7.16	4.33	8.48	5.52

Number of C. chinensis adult emergence in 100 g chickpea seeds treated with different botanical materials and inert dust after 2 month :

The results presented in Table 2 indicated significant differences in number of *C. chinensis* adults emergence in chickpea seeds treated with different botanicals and inert and dust after 2 month. Maximum protection (no adult emergence) was obtained when chickpea seeds were treated with ash and neem oil. The treatment Tulsi leaf powder (42.67 adult emergence/ 100 g seeds) was found least effective.

Number of C. chinensis adult emergence in 100 gm chickpea seeds treated with different botanical materials and inert dust after 3 month :

The results presented in Table2 indicated significant differences in number of *C. chinensis* adult emergence in chickpea seeds treated with different botanical materials and inert dust after 3 month. Maximum protection (no adult emergence) was obtained when chickpea seeds were treated with neem oil and ahs. The treatment with turmeric powder (136.67 adult emergence/ 100 gm seeds) was found least effective. Khaire *et al.* (1992) also found more or less similar results.

Table 2 : Effect of various botanical materials against *C. chinensis* for adult mortalityafter 3 days of release and adult emergence in stored chickpea at monthly interval

Treatment	Adult mortality after 3 days of release (%)	Number of adult emergence per 100 gm seed after			
		1month	2 month	3 month	4 month
Garlic powder	63.40	7.67 cd	34.00 d	84.65 d	105.00 c
Ginger rhizome powder	65.33	6.68 d	24.33 f	28.33 g	47.67 gh
Turmeric powder	39.00	12.67 b	38.34 c	136.67 b	150.68 b
Tulsi leaf powder	27.00	11.64 b	42.67 b	114.68 c	136.64 b
Neem leaf powder	55.67	5.00 f	21.33 g	27.64 gh	52.63 ef
Sesame oil	32.33	8.00 c	26.65 e	29.65 g	48.00 g
Castor oil	29.67	6.68 de	23.68 fg	25.67 h	51.67 f
Mustard oil	29.00	8.63 c	16.67 i	37.33 f	54.69 de
Coconut oil	27.67	5.62 ef	1 8.64 hi	42.69 e	57.33 d
Karanj oil	86.12	4.68 f	7.00 j	11.34 i	13.00 i
Neem oil	100.00	0.00 g	0.00 k	0.00 j	0.00 j
Ash	100.00	0.00 g	0.00 k	0.00 j	0.00 j
Control	0.00	48.33 a	95.33 a	198.67 a	401.68 a
S. Em. ±	0.97	0.38	0.60	1.06	5.44
C. D. at 5 %	2.82	1.68	1.74	3.07	15.82
C. V. %	3.35	10.34	3.87	3.23	10.95

Number of C. chinensis adult emergence in 100 g chickpea seeds treated with differen botanical materials and inert dust after 4 month :

The results presented in Table 2 indicated significant differences in number of *C. chinensis* adult emergence in chickpea seeds treated with different botanical materials and inert dust after 4 month. Maximum protection (no adult emergence) was obtained when chickpea seeds were treated with neem oil and ash. The treatment with turmeric powder (150.68 adult / 100 g seeds) was found least effective.

Evaluation based on chickpea seed damage :

Effect of different botanicals and inert dust on chickpea seeds damage by C. chinensis after 4 month:

The results presented in Table 3 indicated significant differences in damage of treated chickpea seeds with different botanicals and inert dust by *C. chinensis* after 4 month. Maximum protection (no damage) was obtained when chickpea sees were treated with ash (0.00 %) and neem oil (0.00 %). The treatment turmeric powder (20.33 %) was found least effective. The order of effectiveness based on damage of treated chickpea seeds with different botanical materials and inert dust by *C. chinensis* after 4 month was ash (0.00 %) = neem oil (0.00 %) < karanj oil (1.64 %) < ginger rhizome powder (5.67 %) < sesame oil (6.49 %) < caster oil (6.88 %) < neem leaf powder (7.00 %) < mustard oil (7.28 %) < coconut oil (7.65 %) < garlic powder (14.51 %) < Tulsi leaf powder (17.67 %) < turmeric powde (20.33%).

Table 3 : Effect of botanical materials on per cent seed damage due to *C. chinensis* after four month

Treatment	Seed damage %
Garlic powder	14.51
Ginger rhizome powder	5.67
Turmeric powder	20.33
Tulsi leaf powder	17.67
Neem leaf powder	7.00
Sesame oil	6.49
Castor oil	6.88
Mustard oil	7.28
Coconut oil	7.65
Karanj oil	1.64
Neem oil	0.00
Ash	0.00
Control	75.67
S. E. ±	0.30
C. D. (P=0.05)	0.88
C. V. %	4.00

The treatment with 1 % ash or neem oil or karanj oil effectively protected stored chickpea seed up to 4 months.

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