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# EVALUATION OF POISON BAITS AGAINST TOBACCO CATERPILLAR, *SPODOPTERA LITURA* (LEPIDOPTERA : NOCTUIDAE) IN CASTOR

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**ABSTRACT : Laboratory and field experiments were conducted during 2014-2016 to find out the effective poison bait composition for the preference and efficacy against tobacco caterpillar, *Spodoptera litura* (Lepidoptera: Noctuidae) in castor. Free-choice test conducted to study the preference of fourth instar larvae of *S. litura* revealed that wheat bran with jaggery (10:1 ratio) recorded the highest attraction (16.7 to 25.3%) at 24-hrs after release followed by deoiled rice bran with jaggery (13.3 to 17.3%) and rice bran with jaggery (12.7 to 14.7%). No-choice test conducted to study the efficacy of insecticides in wheat bran with jaggery bait formulations against fourth instar larvae of *S. litura* resulted 90 to 97.5% mortality with chlorpyriphos 20EC and 75 to 92.5% mortality with novaluron 10EC at 48-hrs after treatment. Field experiments conducted to evaluate the efficacy of five poison baits revealed that wheat bran + sugarcane jaggery + chlorpyriphos 20EC bait was found effective and resulted in maximum larval mortality of 51.1 to 53.3% and 43.3 to 56.7% as compared to 45.6 to 50% and 42.2 to 52.2% mortality in standard check *viz*., rice bran + sugarcane jaggery + monocrotophos 36SC during *kharif* 2014-15 and 2015-16, respectively. The poison bait containing 50 kg wheat bran, 5 kg sugarcane jaggery and chlorpyriphos 20EC @ 1250 ml/ha can be opted for inclusion as component in the Integrated Pest Management system for the control of late instar larvae of *S. litura* in castor.**

***Key words :*** Castor, *Spodoptera litura*, poison baits, management.

## INTRODUCTION

The tobacco caterpillar, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae) is a polyphagous insect pest of national importance causing economic damage to a number of agricultural crops. It is known to cause damage on castor, groundnut, sunflower, tobacco, cotton, chillies, pulses, cole crops etc. (Murthy *et al*, 2007; Patil *et al*, 2015). Castor is one of the highly preferred hosts and the pest is active during August to November in Southern India. The early instar larvae feed gregariously on the under surface of the leaf by scrapping off the chlorophyll leading to appearance of papery membranes. Later, they disperse, become solitary and nocturnal and cause severe defoliation (Duraimurugan and Lakshminarayana, 2014). Late instar larvae of *S. litura* hide during the day time under the plants and migrate to new plants. Migration of late instar larvae of *S. litura* in groups from one field to another is reported whenever severe outbreak. Hence, the feeding behaviour of *S. litura* necessitates to include management strategies against migrating larvae in addition to foliar spray. Effective management of *S. litura* using poison bait consisting of rice bran, jaggery and monocrotophos was reported in groundnut and potato (Basavaraju *et al*, 2010; Chandrasekhar, 1992; Hiremath, 1993). But, increased cost of rice bran after popularisation of rice bran oil as edible oil in the recent years and keeping of monocrotophos under restricted use in some crops by Central Insecticide Board and Registration Committee (CIB&RC, 2014) necessitates to identify alternate poison bait compositions for the management of *S. litura*. Hence, the present study was undertaken to determine the effective poison bait composition for their preference and efficacy against late instars larvae of *S. litura* in castor.

## MATERIALS AND METHODS

### Test insects and maintenance

Laboratory culture of *S. litura* was established from the egg masses collected from castor fields at Research Farm, Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad and the culture maintained on castor leaves (cv. VP1) at ambient conditions (27±2ºC, 60-70% RH) (Govindan *et al*, 2012). The egg masses were kept in the egg cage. The larvae on hatching were transferred to clear disinfected buckets (7 l capacity) covered with muslin cloth and secured with rubber bands. The larvae were maintained in the rearing buckets at 300, 100, 50, 25 numbers during the first, second, third and fourth instar stages, respectively to avoid overcrowding and fed with fresh castor leaves every day. The grown up larvae were allowed to pupate in soil. Moths were collected on emergence and released in oviposition cage for egg laying. The required number of larvae for the different treatments were taken from the culture.

**Laboratory evaluation of bait compositions against *S. litura***

Laboratory experiment was conducted to study the preference of fourth instar larvae of *S. litura* towards different bait compositions. Three base materials *viz*., deoiled rice bran, rice bran and wheat bran were used with two attractants *viz*., sugarcane jaggery and palm jagerry. The baits were prepared using bran as carrier and jaggery as attractant in 10:1 ratio and sufficient quantity of water was added to make it into small balls. Baits were kept in small gunny bags for 48 hours for ensuring fermentation and used for the experiment. Baits prepared in this manner were tested for their preference on fourth instar larvae of *S. litura* using 'free-choice' test by placing 50g each bait along the inner periphery of the circular plastis trough (16 cm height and 60 cm diameter) at equal distances and 50 number of larvae were released at the centre of the trough and covered with muslin cloth. The experiment was conducted in a completely randomized design comprising of six treatments with six replications. The number of larvae attracted and settled to each bait composition were recorded at 24 hr after release and the per cent attraction was worked out.

**Laboratory evaluation of insecticides in bait compositions against *S. litura***

Efficacy of two insecticides *viz*., novaluron 10EC and chlorpyriphos 20EC was tested in wheat bran based bait formulations that was found promising from the first experiment against fourth instar larvae of *S. litura* under laboratory conditions using no-choice test. Since, there is no standardized recommendation available on the rate of insecticides to be used in bait preparations, it is empirically calculated based on their dosage recommended for spray application and considering the spray volume required per hectare (Renju *et al*, 2009; CIBRC, 2014). Novaluron 10EC @ 750 ml/ha and chlorpyriphos 20EC @ 1250 ml/ha were used for the experiment. The experiment was conducted in completely randomised design comprising 6 treatments with four replications (Table 1). The insecticide bait formulations were prepared by dissolving jaggery at 5 kg/ha in 12 litres of water and after an hour the insecticide was added to the jaggery and mixed thoroughly. The wheat bran at 50 kg/ha was then added to the insecticide mixed jaggery solution by continuous stirring with a stick so that the bait is formed into small balls. After the preparation, poison baits were kept in gunny bags for 48 hours for ensuring fermentation. Later 100g each of poison baits were kept into plastic jars (28 cm height × 12 cm diameter) and the laboratory reared fourth instar larvae of *S. litura* were released into the jars @ 10 larvae/jar/replication. 100 g mixture of wheat bran + sugarcane jaggery and wheat bran + palm jaggery without insecticide was also kept as checks. The jar was covered with muslin cloth and kept at ambient conditions (27±2ºC, 60-70% RH). Observations were taken on number of dead larvae at 24 and 48 hours after the release of larvae and the per cent mortality was worked out.

**Field evaluation of poison baits against *S. litura* in castor**

Field experiments were carried out at Research Farm, ICAR-Indian Institute of Oilseeds Research, Rajendranagar, Hyderabad (Latitude 17.53º N, Longitude 78.27º E, Altitude 545 m.s.l.) to evaluate the efficacy of poison baits against *S. litura* on castor during *kharif* 2014-15 and 2015-16. For the purpose, castor cultivar, DCS-107 was raised in plots of size 4.5 x 6.0 m with a spacing of 90 × 60 cm with recommended agronomic practices except for insect-pest management. The experiment was laid out in a Randomized Block Design with seven treatments including untreated control and replicated three times. The treatments included four poison bait compositions *viz*., wheat bran + sugarcane jaggery+ novaluron, wheat bran+ sugarcane jaggery+ chlorpyriphos, wheat bran+ palm jaggery+ novaluron, wheat bran+ palm jaggery+ chlorpyriphos in comparison with recommended poison bait composition *viz*., rice bran + sugarcane jaggery + monocrotophos and foliar spray of profenofos 50 EC @ 500ml/ha as standard checks for comparison. The poison bait was prepared as detailed earlier using 50 kg of bran, 5 kg of jaggaery and the respective insecticides at recommended doses (novaluron 10EC @ 750 ml/ha; chlorpyriphos 20EC @ 1250 ml/ha; monocrotophos 36SL@ 1250 ml/ha) with 12 litres of water. Treatments were made during October coinciding with primary spike development stage of the crop. Since late instar larvae of *S. litura* are highly migratory in nature, each plot was fenced all around with polythene sheets (Fig. 1a). To assess the efficacy against late instar larvae of *S. litura*, inundative releases of fourth instar larvae of *S. litura* were undertaken at 30 larvae per plot and the treatments were made 24 hours later to ensure larval establishment on the plant. The poison baits were spread between the rows near the plants during evening hours. Observations were taken on number of dead larvae at 3 days after treatment (Fig. 1b). Mortality percentages were worked out and the data subjected to statistical analysis.

**Statistical analysis**

For laboratory experiments, the per cent preference and mortalities were transformed to arcsine percentage and subjected to statistical analysis adopting completely

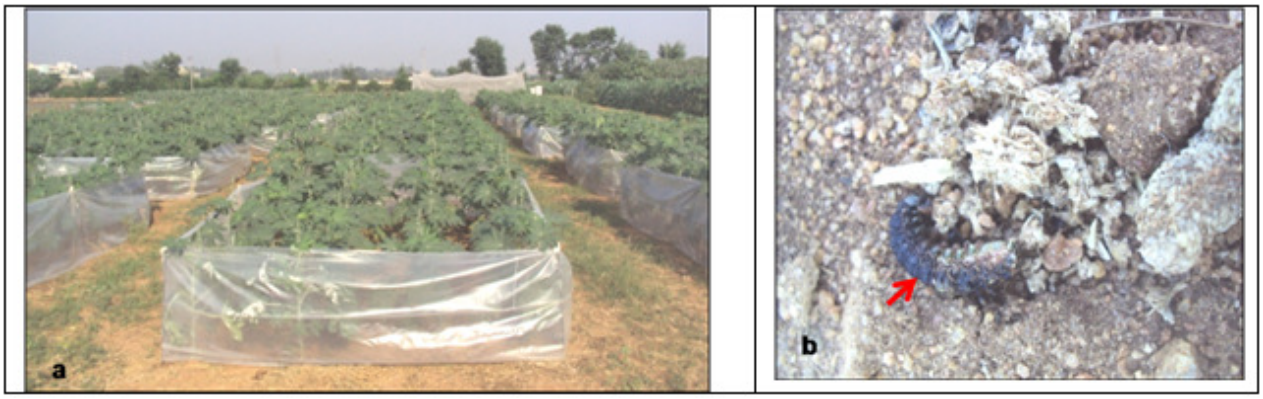


**Fig. 1 : a.** Field view of experimental castor crop, **b.** Larval mortality after feeding on poison bait.

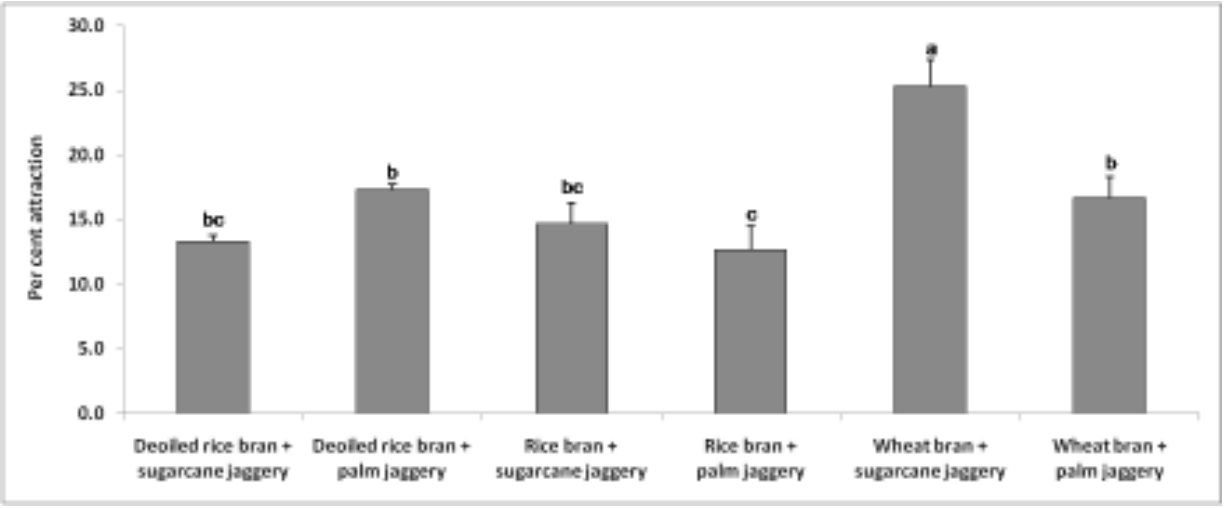


**Fig. 2 :** Preference of fourth instar larvae of *Spodoptera litura* towards different bait compositions under free-choice test at 24-hours after release.

randomised design. In the randomized block design analysis, the data expressed in terms of percentage were converted to arcsine percentage values and subjected to statistical analysis using Agres statistical software. Following ANOVA, differences between datasets were determined using least significant difference at P = 0.05 in all instances.

## RESULTS AND DISCUSSION

### Evaluation of effective base material in bait composition against *S. litura*

From the laboratory experiment conducted to determine the effective base material in bait composition to attract the fourth instar larvae of *S. litura*, it was observed that the wheat bran with jaggery recorded significantly higher attraction (16.7 to 25.3%) at 24-hours after release as compared to deoiled rice bran with jaggery (13.3 to 17.3%) and rice bran with jaggery (12.7 to 14.7%) (Fig. 2). These findings were in conformity to those reported by Parasuraman *et al* (1985), who found that wheat flour with 20 per cent molasses attracted more larvae of *S. litura* and could maintain their feeding as compared to rice bran with 20 per cent molasses. This is also in confirmation with the reports of Hill *et al* (1983) who reported that wheat bran or kibbled wheat based poison baits were found superior to commercial baits for larvae of greasy cutworm, *Agrotis ipsilon*. Use of deoiled rice bran as base material in bait composition was not reported earlier. The present study showed no difference between deoiled rice bran and rice bran in attracting the larvae of *S. litura*. However, wheat bran was found more attractive than rice bran baits.

### Evaluation of insecticides in bait compositions against *S. litura*

The laboratory experiment revealed that wheat bran + sugarcane jaggery + chlorpyriphos 20EC and wheat bran + palm jaggery + chlorpyriphos 20EC was found to be effective against fourth instar larvae of *S. litura* and recorded significantly higher mortality of 97.5% and 90.0% when exposed for 48 hrs, respectively (Table 1). Wheat bran + palm jaggery + novaluron 10EC and wheat bran + sugarcane jaggery + novaluron 10EC recorded 92.5% and 75.0% mortality at 48-hours after treatment,

**Table 1 :** Effect of insecticides in bait compositions against fourth instar larvae of *S. litura* under laboratory conditions.

| Treatments | Percentage mortality at | |
|---|---|---|
| | 24 hrs | 48 hrs |
| Wheat bran + sugarcane jaggery + novaluron 10EC | 22.5(27.9)[b] | 75.0(60.9)[b] |
| Wheat bran + palm jaggery + novaluron 10EC | 27.5(30.8)[b] | 92.5(78.5)[ab] |
| Wheat bran + sugarcane jaggery + chlorpyriphos 20EC | 57.5(49.4)[a] | 97.5(84.9)[a] |
| Wheat bran + palm jaggery + chlorpyriphos 20EC | 62.5(52.3)[a] | 90.0 (79.7)[a] |
| Wheat bran + sugarcane jaggery© | 2.5(5.0)[c] | 2.5(5.0)[c] |
| Wheat bran + palm jaggery© | 2.5(5.0)[c] | 5.0(9.5)[c] |
| LSD (p=0.05) | 12.09 | 18.04 |

©- Checks; Figures in parentheses are arc sin transformed values; In a column, means followed by a common letter(s) are not significantly different.

**Table 2 :** Field evaluation of poison bait compositions against fourth instar larvae of *S. litura* in castor (*kharif* 2014-15 and 2015-16).

| Treatments | Percentage mortality at 3 DAT | | | |
|---|---|---|---|---|
| | *kharif* 2014-15 | | *kharif* 2015-16 | |
| | First application | Second application | First application | Second application |
| Wheat bran + sugarcane jaggery + novaluron 10EC | 37.78 (37.86)[c] | 40.00 (39.22)[c] | 28.89 (32.50)[d] | 35.55 (36.54)[bc] |
| Wheat bran + palm jaggery + novaluron 10EC | 34.45 (35.92)[c] | 34.44 (35.93)[c] | 28.89 (32.45)[d] | 31.11 (33.86)[c] |
| Wheat bran + sugarcane jaggery + chlorpyriphos 20EC | 53.33 (46.92)[b] | 51.11 (45.64)[b] | 56.67 (48.86)[b] | 43.33 (41.16)[b] |
| Wheat bran + palm jaggery + chlorpyriphos 20EC | 51.11 (45.64)[b] | 51.11 (45.65)[b] | 48.89 (44.36)[c] | 37.78 (37.90)[bc] |
| Rice bran + sugarcane jaggery + monocrotophos 36SC | 45.56 (42.45)[bc] | 50.0 (45.0)[b] | 52.22 (46.28)[bc] | 42.22 (40.47)[b] |
| Foliar spray of profenophos 50EC | 73.33 (59.21)[a] | 71.12 (57.55)[a] | 65.56 (54.14)[a] | 66.67 (54.75)[a] |
| Untreated control | 0.0 (0.63)[d] | 0.0 (0.63)[d] | 0.0(0.63)[e] | 0.0 (0.63)[d] |
| LSD (p=0.05) | 7.41 | 4.67 | 4.35 | 5.43 |

DAT - Days after treatment; Figures in parentheses are arc sin transformed values; In a column, means followed by a common letter(s) are not significantly different.

respectively. The present finding is in agreement with Shankaragouda *et al* (2015) on efficacy of chlorpyriphos bait against *S. litura* under laboratory conditions. They could get cent per cent mortality of *S. litura* larvae when exposed for 72 hours to chlorpyriphos 20 EC based poison bait and found superior to lambda cyhalothrin 5 EC, profenofos 50 EC, novaluron 10 EC, methoxyfenozide 20 SC and monocrotophos 36 SL based poison baits. Similar results were also observed by Renju *et al* (2009), who indicated the superiority of chlorpyriphos as effective poison baits against fourth instar larvae of armyworm, *Mythimna separata* as compared to spinosad 45 SC, indoxacarb 14.5 SC, lambda cyhalothrin 5 EC and profenofos 50 EC based poison baits.

### Field evaluation of poison baits against *S. litura* in castor

The field efficacy of different treatments against *S. litura* at 3 days after application are presented in Table 2. Among the poison baits tested, wheat bran + sugarcane jaggery + chlorpyriphos 20EC bait found effective and resulted maximum per cent larval mortality of 51.1 to 53.3% and 43.3 to 56.7% as compared to 45.6 to 50% and 42.2 to 52.2% mortality in standard check (rice bran + sugarcane jaggery + monocrotophos 36SC) during *kharif* 2014-15 and 2015-16, respectively. Novaluron 10EC in bait compositions found less effective and recorded 28.89 to 40.0% larval mortality. Foliar sprays of profenophos recorded 65.56 to 73.33% larval mortality and found significantly superior over poison bait treatments. Kulkarni (1989) reported chlorpyriphos bait as quite effective in controlling *S. litura* in groundnut, where he reported 63.77 to 72.14% reduction in larval population over check during *kharif* and summer seasons. Ramana *et al* (1988) reported that use of chlorpyriphos bait at 0.5% and 1.0% resulted into 47.94% and 52.60% reduction of larvae over control respectively in *rabi* groundnut, when applied against *S. litura*. Renju *et al* (2009) indicated the efficacy of chlorpyriphos against *M. separata* on sorghum. Basavaraju *et al* (2010) reported

that poison baits with insecticides found highly effective against *S. litura* and recorded higher yield over foliar spray of insecticides in potato ecosystem. The present investigation revealed that bait application was not found superior over foliar application of insecticide in the control of *S. litura* in castor. The variation of this result from the previous investigations may be due to the difference in host plants, crop stature, infestation level, season and microclimate of the locality. Poison bait is primarily recommended in situations where spraying or dusting are not practicable as in case of migration of cutworms and armyworms (*Spodoptera* spp. and *Agrotis* spp.) under outbreaks and control of late instar larvae of *S. litura* during cyclonic weather conditions. Bait formulations provide several advantages over other insecticide application methods. Baits are useful when control programmes are conducted where preservation of beneficial species of arthropods is important. Wide array of potential biocontrol agents like parasitoids, predators and microbial agents have been documented in castor which provides up to 75 per cent control of the major insect pests of castor in the field under favourable conditions (Duraimurugan *et al*, 2015). Hence, it could be concluded that poison bait using wheat bran + sugarcane jaggery + chlorpyriphos 20EC can be opted for inclusion as component in the Integrated Pest Management system for the control of late instar larvae of *S. litura* in castor.

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