Short Communication

A phagostimulant based bait composition for tobacco caterpillar *Spodoptera Litura* (Fabricius) (Lepidoptera: Noctuidae)

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Received 20 June 2018 ; received in revised from 16 February 2019; accepted 19 February 2019

Abstract

Laboratory studies were conducted during 2017-2018 at the Department of Agricultural Entomology, College of Horticulture, Vellanikkara, Kerala Agricultural University, Thrissur, to evaluate different base materials and a phagostimulant, which could serve as baits for *Spodoptera litura* (Fabricius) (Lepidoptera: Noctuidae). Baits were prepared using different bran materials such as rice bran, maize bran and wheat bran, along with jaggery and water. Mean consumption of bait by six-day old *S. litura* larvae after 48h revealed superiority of wheat bran (4:1:4 ratio), followed by maize bran. Addition of phagostimulants such as corn starch and coconut oil were found to increase the consumption of bait. The bait composition identified would be extremely helpful in preparing insecticide based poison baits for the management of *S. litura.*

Key words: Bait, Phagostimulants, *Spodoptera litura,* Wheat bran.

Spodoptera litura is a notorious polyphagous pest with a host range of about 120 species, causing severe defoliation in economically important crops such as rice, vegetables, cotton, tobacco, etc. On most crops, damage arises from extensive feeding by larvae, leading to complete defoliation of the plants. Insecticide sprays are one of the most common tools currently used for the management of *S. litura*. Extensive use of insecticides has resulted in wide spread development of insecticide resistance along with non-target effects on beneficial insects like pollinators and natural enemies (Pimental, 1995; Armes et al., 1997; Kranthi et al., 2002; Shankarganesh et al., 2012).

Runoff and drift problems in conventional insecticide dusts and sprays can be reduced by the use of poison baits. Poison baits can help in preserving beneficial insects, as they provide greater selectivity compared to dusts and liquids (Barbara and Capinera, 2003). To tide over the problems caused by insecticides, poison baiting of *S. litura* is an efficient management strategy.

Baiting technique comprises an attractive food to lure insect pests along with an insecticide. The use of materials that elicit feeding could aid in pest control by altering the behavior of early instars. This concept might be useful in integrated management of insect pests. Poison baits consisting of an effective base material and an attractive phagostimulant would increase the consumption by insects, resulting in increased poisoning and improved pest control. In this study, we have tried to determine the effectiveness of base materials along with a phagostimulant for the preparation of an attractive bait for *S. litura*.

A laboratory culture of *S. litura* was established from field collected larvae. The larvae were reared on an artificial diet (Mani and Rao, 1998). Six day old larvae obtained from the laboratory culture were

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used for the study

Rice, wheat and maize bran were evaluated for their effectiveness as base material for the preparation of baits for *S. litura*. Baits were prepared by using different brans as base material along with jaggery and water in different ratios. All the constituents for the preparation of base material were procured from local market. Three different ratios of the constituents *viz.,* 12.5:1:1, 12.5:1:4 and 4:1:4 of bran, jaggery and water (on w/w basis) were evaluated. Commonly available bran materials such as rice bran, wheat bran and maize bran were assessed. Bait was prepared in different proportions and kept for fermentation for a period of 48 hours. One gram each of prepared and fermented bait was weighed and transferred to clean petri plates. Six-day old *S. litura* larvae were released into petri plates for feeding, with three larvae/ petri plate. All the three treatments were replicated five times. Larvae were allowed to feed for 48 h and the weight of the bait remaining in each petri plate was recorded after the removal of faecal pellets. Observation on weight of the bait consumed was recorded by calculating the difference between the initial weight and final weight of the base material. The base material which recorded the highest consumption by *S. litura* larvae was chosen for further studies on phagostimulants. Standardisation of base material was followed by the evaluation of phagostimulants with an objective to increase the attractiveness of bait material. Yeast (1%), starch (0.2%) and coconut oil (1%) were evaluated as phagostimulant for the standardised base material. Weighed quantity of phagostimulants were added to the selected base material and was kept for fermentation for a period of 48 h. One gram each of the fermented bait was weighed and taken in petri plates. Three numbers of six day old larvae were released into each petri plate. Five replications were kept for each phagostimulant treatment. Bait consumed in each replicate was calculated by weighing the remaining quantity of bait after a period of 48 h. Faecal pellets were removed from each petri plate before weighing. Bait prepared without the addition of any phagostimulant served as control. Data were analysed in SPSS 16.0 in CRD and means were separated by Tukey's test.

Cannibalism among larvae was observed when bait was prepared in the ratio 12.5:1:1 and 12.5:1:2 with rice bran, wheat bran and maize bran, which showed the reduced acceptability of these bait proportions, irrespective of the bran used. Larvae accepted and consumed the bait, without any cannibalism when bait was prepared in the ratio 4:1:4. Bait prepared with all the three bran materials in this ratio was found palatable to six day old *S. litura* larvae.

Scientists have evaluated different proportions for the preparation of baits for different lepidopteran pests such as 12.5:1:2 rice or wheat bran, jaggery, water (Hiremath et al.,1990), 12.5:1.25:1 rice bran, jaggery and water (Basavaraju et al., 2010), 8:2 rice bran and jaggery (Viswanadham et al., 1986) and 4:1:2 rice bran, jaggery and water (Sreedhar and Nageswararao, 2016). Our results were in agreement with the studies of Viswanadham et al., (1986), who reported 8:2 ratio of rice bran and jaggery as effective in attracting larvae of *S. litura.* In the bait prepared by Viswanadham et al., (1986), water was added in sufficient quantity to form the bait into a ball. In the current study 4:1:4 ratio of bran, jaggery and water was accepted by the larvae, which is identical to the proportion used by Viswanadham et al. (1986).

Increased acceptance of 4:1:4 ratio of bait material could be due to the increase in proportion of jaggery and higher moisture content in the bait. Addition of jaggery as a phagostimulant was found to improve the acceptability of bait in several studies (Dhandapani et al., 1993; Singh and Battu, 2006; Doddabasappa et al., 2013).

Bait prepared with a higher moisture content (4:1:4) was preferred over bait with lower moisture content (12.5:1:1 and 12.5:1:2). Gholson and Showers (1979) had also observed increased attraction of cut worm, *Agrotis ipsilon*, to wet baits over dry baits. Similarly, palatability and consumption were

significantly higher when wheat bran with higher moisture content was used as bait against cutworms (Martin, 1980). In the current investigation also moist baits attracted more larvae. Preparation of extremely dry baits without enough moisture may reduce the palatability.

Once the proportion for preparation of baits was standardised, experiments were laid out to evaluate the acceptance and palatability of various bran materials. As the efficacy of any poison bait depends upon the palatability of bait components, it was imperative to assess various commonly available bran materials for their phagostimulatory effect, palatability and effectiveness (Barbara and Capinera, 2003). For most of the studies carried out in India, rice bran was utilised for poison baiting (Abdul Kharim and Viswanadham, 1980; Viswanadham et al., 1986; Renju et al., 2009; Shankaragouda et al., 2015; Sreedhar and Nageswararao, 2016; Muddasar et al., 2017). However, a comparative study on the effectiveness of various brans for the preparation of baits has not been done. Hence, it is imperative to assess the base materials and their proportion for better palatability to the insects before finalising the base material for bait preparation.

Among the various bran materials evaluated for the preparation of bait, wheat bran was significantly superior over rice bran and maize bran (Table 1). Mean weight of bait consumed was 0.1980g with wheat bran, 0.1753g with maize bran and 0.1493g with rice bran. The consumption was significantly lower in baits prepared with rice bran, compared to the other two bran materials.

Table 1. Consumption of bait after 48 h of feeding by *S. litura*

Base material	Weight of bait consumed (g)
Rice bran + jaggery + water	0.1493[c]
Wheat bran + jaggery + water	0.1980[a]
Maize bran + jaggery + water	0.1753 [b]

(Values followed by same letter are not significantly different at 5% level. Means separated by Tukey's test). n= average of 5 replications

Wheat bran was also reported to be more palatable when compared to kibbled wheat and corn flour for the preparation of bait against *Agrotis ipsilon* (Martin, 1980). Martin (1980) hypothesised that increased acceptability of wheat bran may be due to its shape or crushed nature of grain. Wheat bran was chosen for the preparation of bait for the management of armyworms in wheat (Dahms and Fenton, 1942), cut worms in tobacco (Turner, 1950) and mole crickets, greasy cut worms and grasshoppers in various crops (Barbara and Capinera, 2008). Wheat flour and rice bran with different concentrations of molasses as phagostimulant was evaluated by Parasuraman et al. (1985), who found wheat flour with 20 per cent molasses as superior in attracting and maintaining the larvae of *S. litura* in baits. Our study has also identified wheat bran as the most accepted base material over the commonly used rice bran and maize bran.

Addition of phagostimulants can increase the consumption rate of insects, thereby increasing the mortality of insects in poison baits. In order to further improve the consumption and palatability of bait, 1 per cent yeast, 0.2 per cent starch (corn starch) and 1 per cent coconut oil were added to wheat bran based bait as phagostimulants. Addition of 0.2 per cent starch, almost doubled the consumption of bait over that without phagostimulant (Table 2). Consumption of bait containing 0.2 per cent starch was 0.3842 g, while in bait without any phagostimulant, it was 0.1975 g. Addition of coconut oil also significantly

Table 2. Consumption of bait after 48 h of feeding by *S. litura*

Base material + phagostimulants	Weight of bait consumed (g)
Wheat + yeast 1%	0.1975[b]
Wheat + starch 0.2%	0.3842[a]
Wheat + coconut oil 1%	0.3725[a]
Control (without phagostimulants)	0.1975[b]

Values followed by same letter are not significantly different at 5% level. Means separated by Tukey's test). n= average of 5 replications Baits prepared with wheat bran, jaggery and water in the ratio (4:1:4) with starch (0.2%) or coconut oil (1%) as phagostimulant increased the feeding of bait by *Spodoptera litura.*

improved the consumption of bait. The consumption of bait with coconut oil was 0.3725 g. There was no difference in consumption of bait upon addition of yeast (1%) as the weight consumed after 48 h was 0.1975 g with both control and bait containing yeast.

Corn starch is a proven phagostimulant to lepidopterous larvae in formulations containing *Bacillus thuringiensis* (Dunkle and Shasha, 1988; Bartelt et al., 1990; Rosas-Garcia et al., 2009). Starch was found to enhance the phagostimulant effect of a nucleopolyhedrovirus formulation to *Spodoptera frugiperda* in maize (Castillejos et al., 2002).

Vegetable oils such as corn oil, cotton seed oil and soybean oil were used as phagostimulants to various lepidopterous larvae such as *Ostrinia nubilalis*, *Heliothis* spp. and *Spodoptera littoralis* (Ave, 1995). Phagostimulant action of another vegetable oil, coconut oil, was observed in the present study, which can be utilised for the preparation of more attractive and palatable poison baits for *S. litura* larvae.

Addition of yeast (0.1 per cent) did not significantly enhance the consumption of the bait, when compared to bait with rice alone, while addition of jaggery and molasses significantly increased the consumption of bait by *S. litura* larvae (Muddasar et al., 2017). In the present investigation also, consumption of bait was not enhanced by the addition of yeast.

As addition of phagostimulants such as starch (0.2 per cent) and coconut oil (1 per cent) was found to significantly enhance the consumption of bait material, phagostimulants also must be assessed and utilised in the preparation of poison baits.

Acknowledgement

Authors thank Kerala Agricultural University for providing funds and facilities for this study.

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