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Relative efficacy of different whorls application of poison baits against fall armyworm, *Spodoptera frugiperda* (J.E. Smith) on maize crop at Raipur (Chhattisgarh)

Pooja Sinha and Sonali Deole

Abstract
A field experiment was conducted to assess the effectiveness of various whorl applications of poison bait for controlling *Spodoptera frugiperda* (J.E. Smith), the fall armyworm, on maize. Results on efficacy revealed that all selected insecticides as poison bait composition were effective against the target insect. However, the poison bait (Rice bran + Jaggery) prepared by using insecticide Spinetoram 11.7% SC recorded significantly highest mortality of 91.73% was followed by Chlorpyriphos 20% EC which recorded a mortality of 89.20% and Chlorantraniliprole 18.5% SC recorded 86.63% of mortality. Therefore, they can be recommended as effective poison bait. It is suggested to practice whorl application of poison bait with effective chemicals *viz.*, Spinetoram 11.7% SC, Chlorpyriphos 20% EC, Chlorantraniliprole 18.5% SC and Emamectin Benzoate 1.9% EC for eco-friendly and effective management of *Spodoptera frugiperda*.

Keywords: *Spodoptera frugiperda*, maize, management, whorl application, poison bait

Introduction
Corn, usually referred to as maize (*Zea mays* L.), is a member of the Gramineae family. It is a significant cereal crop that is farmed all over the world Araus *et al*. (2002) [1]. It is known as the "Queen of Cereals" or the "Miracle Crop" because it has the largest genetic yield potential of any cereal crop. No other cereal on earth has such enormous potential Rautaray *et al*. (2013) [9].

Arthropod pests are one of the main causes of the low yield of maize and are at the heart of many major issues that currently plague maize agriculture. Despite the use of insecticides, arthropod pests continue to cause significant crop losses today, especially in developing nations Ferdu *et al*. (2001) [3]. More than 141 distinct bug species have been documented on maize in the field. The maize stalk borer (*Busseola fusca*), the spotted stalk borer (*Chilo partellus*), and various termite species (*Macrotermes* and *Microtermes spp*.) are known as the three most serious pests among these. Aside from this, the notoriously destructive and Polyphagous behaviour of the recently established pest fall armyworm *Spodoptera frugiperda* is a major worry. Its powerful ability to fly and distribute over a great area each year may be the primary factor in its rapid proliferation Mallapur *et al, (*2018) [8].

Fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) is native to American continent. It was reported for the first time from the African continent, in Nigeria, Sao Tome´, Benin and Togo region (Goergen *et al*., 2016) [5]. In 2018, reports of *Spodoptera frugiperda* from the Indian subcontinent, Karnataka and Andhra Pradesh (Ganiger *et al*., 2018) [4] (Sharanabasappa Kalleshwaraswamy *et al.*, 2018) [7]. Additionally, Bihar, Chhattisgarh, Gujarat, Maharashtra, Odisha, Tamil Nadu, Telangana, and West Bengal have detected the pest. In India, fall armyworm (FAW) was firstly reported in the research fields of maize at the University of Agricultural and Horticultural Sciences, Shimoga, Karnataka (Sharanabasappa *et al*., 2018). In Chhattisgarh the *Spodoptera frugiperda* was first reported at Raipur (Deole and Paul, 2018) [2].

An efficient and specialised approach of controlling insects is to use poison baits based on food. The typical components of a bait are a base substance called a carrier (commonly grain or animal protein), a toxicant (most frequently insecticides like organophosphates, Carbamates, or Pyrethroid), and occasionally an addition (typically oil, sugar, or water to boost attraction).

Additionally, a bait's harmful component can be biological rather than chemical. Although many baits are not drawn to the basic material, they find it tasty and will consume it when they come to it. Therefore, to achieve wide dispersion, baits are disseminated by either ground or aerial broadcast application. Toxic baits are frequently effective, low-cost ways to control insects. Baits are connected with little to no insecticide spread, if any at all.

Materials and Methods

The experiment was carried out during *kharif* 2022 at Research cum instructional farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The trial was laid out in randomize block design (RBD) with three replications and seven treatments along with untreated check for comparison. The poison baits were applied twice, on 15 and 30 days after the emergence of crop

Preparation of poison bait

Bait was prepared by mixing rice bran and Jaggery (5:1) with enough water. Then the mixture allowed to ferment for 24 hrs. The fermented product was divided into seven equal parts for seven treatment and 10 ml of the insecticidal solution was added to it. Before adding, the insecticidal solution, the formulated insecticides were diluted to a concentration level that caused 90 percent mortality of *S. frugiperda* larvae. The poison baits prepared as tiny balls with a diameter ranging from 5 mm – 6 mm. Rice bran mixed with Jaggery was kept as control. Observations on number of dead larvae at 24 and 48 hours after the application were recorded and the percent mortality was worked out. Fall armyworm pre-treatment observations were made 24 hours prior to application, and post-treatment observations were conducted on five randomly chosen plants from each plot 24 and 48 hours following application. The population statistics for *S. frugiperda* were converted into adjusted percent using the formula below, which Abbott (1925) and Henderson and Tilton (1955) amended.

$$\text{Corrected per cent mortality} = 100 \times 1 - \left\{ \frac{T_a \times C_b}{T_b \times C_a} \right\}$$

Where,
Tb = No. of insect pests observed before treatment.
Ta = No. of insect pests observed after treatment.
Cb = No. of insect pests observed before treatment in control plot.
Ca = No. of insect pests observed after treatment in control plot.

Table 1: Treatment details for whorl application of poison baits

S. No.	Treatment	Formulation (gram or ml *a.i.*/ ha)	Dose (ml/L or g/L)
1	Rice bran + Jaggery+ Spinetoram 11.7% SC	250 ml/ha	0.05ml
2	Rice bran + Jaggery+ Chlorantraniliprole 18.5% SC	200 ml/ha	0.04ml
3	Rice bran + Jaggery+ Emamectin Benzoate 1.9% EC	250 ml/ha	0.05ml
4	Rice bran + Jaggery+ Chlorfenapyr 10% SC	700 ml/ha	0.014ml
5	Rice bran + Jaggery+ Novaluron 10% EC	750ml/ha	0.015ml
6	Rice bran + Jaggery+ Chlorpyriphos 20% EC	1200 ml/ha	0.024ml
7	Rice bran + Jaggery (Control)		

Results and Discussion

First recorded was the armyworm larval population. Five randomly chosen plants from each plot were used to determine the average larvae population. Pre-treatment observations were made one day prior to the administration of poison bait, and post-treatment observations were made after 24 and 48 hours. The observations were recorded after first whorl application of poison bait revealed that, Spinetoram recorded significant highest mortality 54.4% after 24 hours of application of poison bait and was found superior compared to rest of the insecticides. Chlorpyriphos recorded 46.76% of mortality followed by Chlorantraniliprole with significant low mortality (43.50%). Emamectin benzoate recorded 36.96% of mortality after 24 hours. Chlorfenapyr recorded comparatively low mortality rate 34.83%. Among all the insecticides tested as poison baits Novaluron was found least effective with 28.36% mortality. The mortality rate was found double after 48 hours of exposure of larvae to the baits. Spinetoram recorded significant highest mortality of 91.73% followed by Chlorpyriphos bait that recorded a mortality of 89.20% and was on par with Spinetoram. Chlorantraniliprole bait recorded significantly 86.63% of mortality but was on par with Chlorpyriphos. Emamectin benzoate recorded comparatively low mortality of 77.03% but was on par with Chlorantraniliprole bait. Novaluron bait recorded 74.53% mortality and was on par with Emamectin benzoate Chlorfenapyr bait recorded least mortality of 71.93% and was on par with Novaluron.

The observations were recorded after second Whrol application of poison bait revealed that, Spinetoram recorded significant highest mortality of 50.36% after 24 hours of treatment and was found superior compared to rest of the insecticides. Chlorpyriphos recorded 43.73% of mortality followed by Chlorantraniliprole with significant low mortality 40.40%. Emamectin benzoate recorded 33.86% of mortality after 24 hours. Chlorfenapyr recorded comparatively low mortality rate 31.73%. Among all the insecticides tested as poison baits Novaluron was found least effective with 24.76% mortality. The mortality rate was found double after 48 hours of exposure of larvae to the baits. Spinetoram recorded significant highest mortality of 88.50% followed by Chlorpyriphos bait that recorded a mortality of 83.33% and was on par with Spinetoram. Chlorantraniliprole bait recorded significantly 81.66% of mortality but was on par with chlorpyriphos. Emamectin benzoate recorded comparatively low mortality of 73.73% but was on par with Chlorantraniliprole bait. Novaluron bait recorded 68.66% mortality and was on par with Emamectin benzoate. Chlorfenapyr bait recorded least mortality of 68% and was on par with Novaluron. Sreedhar and Nageswara Rao (2016) [12] reported that infestation, leaf damage, yield parameters, net returns and economics were quite promising with baits prepared out of Emamectin benzoate 5 SG @ 11 g *a.i*/ha against *S. litura* under field conditions. Similar findings

against *S. litura* larva were also reported by Shankaragouda *et al.* (2015) [11] using Chlorfenapyr bait. Accordingly, all the four dosages (100, 75, 50 and 25 percent of recommended dosage) recorded cent percent mortality of *S. litura* larvae at 72 hours after exposure of larvae to the baits. Shahanaz (2018) [10] concluded The most effective poison baits for *S. litura* infesting tobacco were determined to be emamectin benzoate, thiodicarb, and chlorpyriphos. Emamectin benzoate 5 SG-prepared rice bran baits were discovered to be successful in controlling *S. litura*. The microbial bioinsecticide was found to be significantly effective in controlling the autumn armyworm larvae, according to Harika *et al*., (2020) [6] *M. relyi* had the lowest foliar damage and the highest percentage of mortality compared to the untreated control.

Table 2: Effect of whorl application of different poison baits on mortality percent of fall armyworm larvae on maize crop

Treatments	First application (15 DAS)			Second application (30 DAS)		
	Pre-treatment observation (larvae per five plants)	Mortality (%)		Pre-treatment observation (larvae per five plants)	Mortality (%)	
		24 hrs.	48 hrs.		24 hrs.	48 hrs.
Rice bran + Jaggery+ Spinetoram 11.7% SC	2.26 (1.80)	54.40 (7.443)	91.73 (9.630)	2.00 (1.73)	50.36 (7.167)	88.50 (9.460)
Rice bran + Jaggery+ Chlorantraniliprole 18.5% SC	2.20 (1.78)	43.50 (6.671)	86.63 (9.361)	1.93 (1.71)	40.40 (6.434)	81.66 (9.092)
Rice bran + Jaggery+ Emamectin benzoate 1.9%EC	1.93 (1.71)	36.96 (6.161)	77.03 (8.834)	1.73 (1.64)	33.86 (5.905)	73.73 (8.645)
Rice bran + Jaggery+ Chlorfenapyr 10% SC	2.00 (1.76)	34.83 (5.986)	71.93 (8.540)	1.80 (1.66)	31.73 (5.721)	68.00 (8.306)
Rice bran + Jaggery+ Novaluron 10% EC	2.13 (1.73)	28.36 (5.419)	74.53 (8.691)	1.86 (1.68)	24.76 (5.076)	68.66 (8.346)
Rice bran + Jaggery+ Chlorpyriphos 20% EC	1.86 (1.69)	46.76 (6.911)	89.20 (9.497)	1.66 (1.63)	43.73 (6.688)	83.33 (9.183)
Rice bran + Jaggery (Control)	1.73 (1.69)	0.00 (0.0)	0.00 (0.0)	1.53 (1.59)	0.00 (0.0)	0.00 (0.0)
S.Em±	0.08	0.35	0.23	0.08	0.34	0.47
CD@5%	N/S	1.11	0.73	N/S	1.08	1.48

Figures in parenthesis are square root transformed values

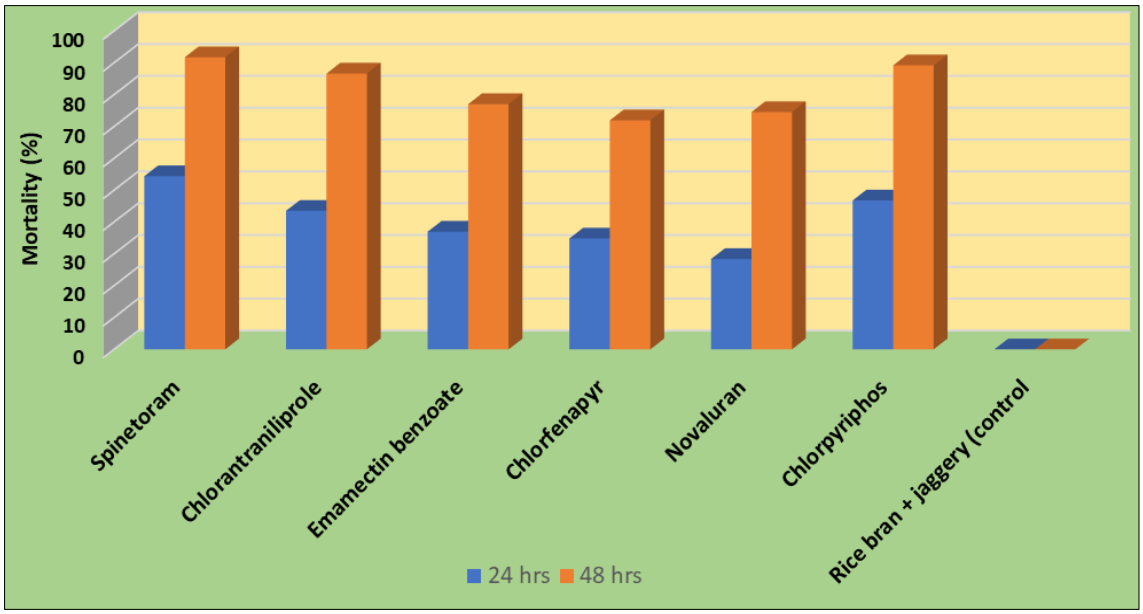

Fig 1: Effect of first whorl application (15 DAS) of different poison baits on mortality percent of fall armyworm larvae on maize

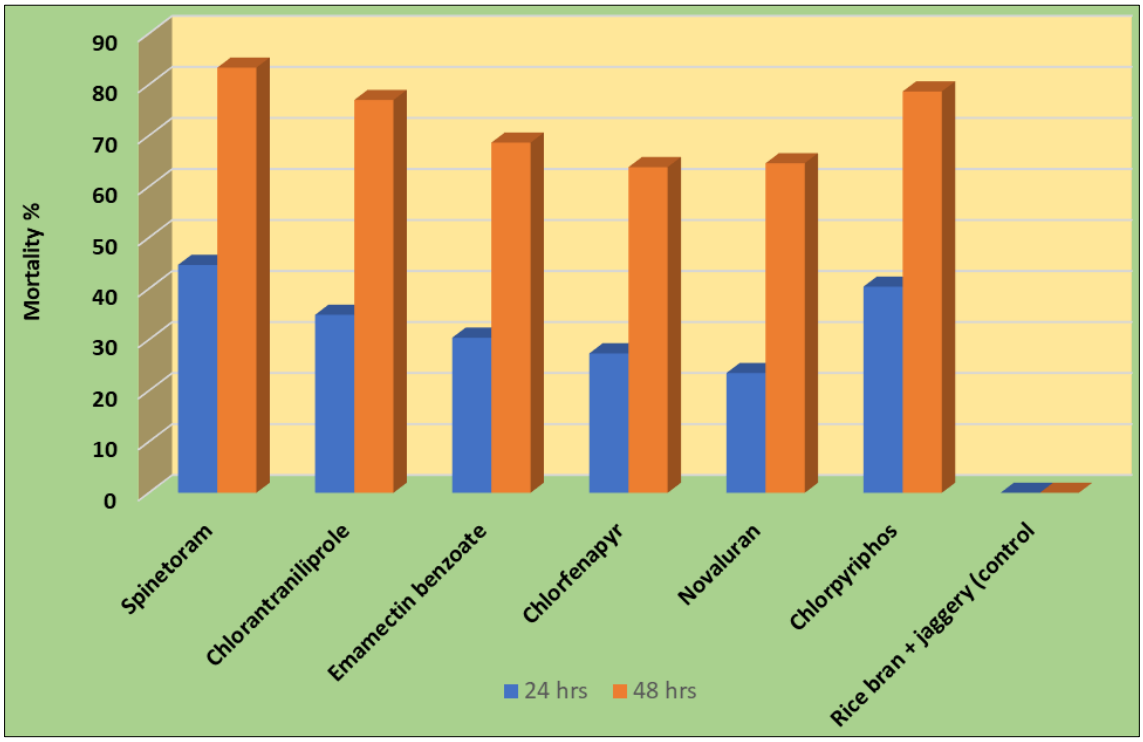

Fig 2: Effect of second whorl application (30 DAS) of different poison baits on mortality percent of fall armyworm larvae on maize

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