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Influence of Pre-Harvest Spray on Seed Infestation and Seed Quality in Field Bean (*Lablab purpureus* L.)

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ABSTRACT: A field experiment was conducted at ARS Madenur, Hassan to investigate the influence of pre-harvest spraying of insecticides and botanicals on pulse beetle and storability of seeds in field bean (*Labalab purpureus* L.) var. HA-4 sown during *Rabi* 2022. Foliar treatments of insecticides and botanicals were used as a pre-harvest sanitation spray at pod maturity stage. Threshed pods were dried to a safer moisture level. Freshly harvested seeds were collected after harvest and graded seeds were taken for initial observation in the laboratory. Among different pre-harvest sprays, Spinosad 45 SC @ 0.04 ml/l resulted in highest 100 seed weight (19.30 g), germination (91.25%), seedling vigour index-I (3728) and seedling vigour index-II (6862), higher total dehydrogenase activity (2.50), lower electrical conductivity of seed leachates (239.25 μScm^{-1}), and nil seed infestation (0.00%), eggs laid (0.00), and eggs hatched (0.00. This study showed that in field bean spraying with Spinosad 45SC @ 0.04 ml/l at pod maturity stage can be practised as a sanitation measure for bruchid management.

Keywords: Seed infestation, insecticide spar, seed quality and field bean

INTRODUCTION

Field bean (*Labalab purpureus* L.) is being grown commercially on large scale in India particularly in Karnataka to meet out the domestic demand for its green pod and dry pulse, which contributes nearly 90 per cent both in terms of area and production in the country [1]. In Karnataka, it is grown annually in an area of 79,462 ha (66,976 ha in *Kharif* and 12,486 in *Rabi* / summer) with a production of 68,014 tonnes with productivity of about 901 kg/ha [2]. It is grown mainly in Bangalore, Kolar, Mysore, Hassan, Dharwad, Belgaum and Bidar Districts of Karnataka. Field bean (*Lablab purpureus* L.) is originated in India and is a locally important crop that belongs to family Fabaceae having chromosome number 2n=22.It is commonly known as field bean, hyacinth bean, Indian bean, Avare, Egyptian bean, Bonavist bean. Lablab bean is a self-pollinated crop; most traditional cultivars are highly sensitive to photoperiod for flowering time with indeterminate growth habit. Seed of lablab bean is viable for 2 to 3 years and has an average germination per cent of 85-95 per cent. Growth period varies from 75 to 300 days. Improved cultivars start fruiting 60- 65 days after sowing and continue for 90-100 days.

Infestation of commodities in the field prior to harvest can be an important consideration in developing a pest management programme for stored-product insects. The pre-harvest sprays with insecticides checks the incidence of pulse beetle (*Callosobruchus* spp) at field conditions, subsequently reducing the carry-over of bruchid population to storage, which helps in improving the yield parameters of the crop [3]. The pre-harvest sanitation sprays with different insecticides and botanicals show residual effects in seeds during storage conditions by preventing the build-up of bruchid population [4]. Considerable research works on seed treatments with various insecticides and botanicals have been carried out for restricting the bruchid population in storage, but, pre- harvest insecticidal application is a novel method to arrest the incidence of pulse beetle at field itself there by delimiting the seed damage during storage. It involves the spraying of insecticides during the formation and development of pods and seeds at required concentrations at suitable intervals [5]. Though the prophylactic measures to check the bruchids activity in the field itself is known yet not much works have been done to explore the possibilities of using them in assessing the carry over bruchid infestation from field to store and their effect on seed quality parameters during storage. Therefore, an attempt was made to study the effect of pre-harvest insecticidal sprays at pod maturing stage of crop growth on field infestation of pulse beetle

in field bean and to evaluate its residual effect on carry over bruchid infestation and seed quality attributes during storage. Hence, present investigation is formulated to overcome the insect infestation and store for longer period.

MATERIALS AND METHODS

The field experiment was conducted at ARS Madenur, Hassan, to investigate the influence of pre-harvest spraying of insecticides and botanicals on pulse beetle and storability of seeds in field bean (*Labalab purpureus* L.) var. HA-4 of field bean seeds. The experiment was initiated on 28th Oct 2022 to 15th March 2023 with nine treatments by adopting completely randomized design with three replications, seeds sown during *Rabi*, 2022 and a foliar treatment of the following insecticides and botanicals were used as a pre-harvest sanitation spray at pod maturity stage.

Freshly harvested seeds were collected at harvest maturity, seeds were cleaned, graded, dried to safer level of moisture (moisture content to be mentioned) and used for the initial observation in the laboratory.

Seed quality parameters *viz.,*100 seed weight, germination, seedling vigour index-I and II, electrical conductivity of seed leachates, total dehydrogenase activity, incidence of insect (bruchid) infestation, number of eggs laid, and number of eggs hatched were recorded

Hundred seed weight

One hundred seeds in four replications were randomly taken out from each treatment and weighed in the electronic balance and the mean of a hundred seed weight was expressed in grams.

Seed germination

One hundred seeds of four replicates were drawn at random from each treatment and the germination test was conducted by using between paper (BP) method as per ISTA rules [6]. The rolled towels were incubated in a germination chamber maintained at 25±10^{o}C and 90 per cent relative humidity. The germinated seedlings were evaluated on fourth and tenth day as first and final counts, respectively and germination percentage was expressed based on normal seedlings.

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds put for germination}} \times 100$$

Seedling vigour indices

The seedling vigour index-I (SVI-I) is determined by multiplying the germination percentage with total seedling length and seedling vigour index-II (SVI-II) was determined by multiplying germination percentage with total seedling dry weight and expressed as whole number for each treatment [7]

- Seedling vigour index-I = Germination (%) x Mean seedling length (cm)
- Seedling vigour index-II = Germination (%) x Mean seedling dry weight (mg)

Electrical conductivity

Twenty-five seeds of four replicates were taken randomly from each treatment in a beaker and soaked in 50ml of double distilled water for 24 h at 25±10^{o}C. The steeped water from soaked seeds was collected and the electrical conductivity (EC) of seed the leachate was measured in a digital conductivity meter. After subtracting the EC of the distilled water from the value obtained from the seed leachate, the actual EC due to electrolytes was estimated and expressed in μScm^{-1}.

Total dehydrogenase activity

Ten seeds were randomly selected from each treatment in four replications. The seed coat was carefully removed and made sure that embryonic axis is soaked in a test tube containing 0.5 percent tetrazolium chloride solution and incubated at 25 ± 1°C in the dark for 4 hours. Further, seeds were washed thoroughly in distilled water, and the red colour formazan from stained embryos was eluted by soaking in 5 ml of 2- methoxy ethanol for 24 hours in an airtight container. The extract was decanted and colour intensity is measured using a spectrophotometer at A_{480}. The dehydrogenase activity is expressed in terms of optical density at A_{480} [8].

Insect infestation

Four hundred seeds were sampled randomly from each treatment in three replications. Seeds were counted for the presence of eggs laid, eggs hatched, exit holes and expressed in a percentage of the total number of seeds counted. Seed damage was calculated based on the method as given below [9, 10].

$$\text{Insect infestation (\%)} = \frac{\text{Number of seeds damaged}}{\text{Total number of seeds counted}} \times 100$$

Number of eggs laid

Hundred seeds were sampled randomly from each treatment in three replications. The number of eggs deposited on each seed will be observed and recorded from each treatment.

Number of eggs hatched

Hundred seeds were selected randomly from each treatment in three replications. The number of egg hatch on each seed will be observed and recorded from each treatment.

RESULTS AND DISCUSSION

Hundred seed weight

The data revealed that hundred seed weight was higher with insecticides. Pre-harvest spray of spinosad45SC @ 0.04 ml/l recorded higher hundred seed weight of 19.30 g followed by emamectin benzoate 5SG @ 0.3 g/l(19.27 g), deltamethrin 2.8EC @ 0.04 ml/l (19.23 g), and they were on par with each other, lowest seed weight was recorded in control (18.49 g). Spinosad was found effective in maintaining seed quality parameters which results in higher test weight due to accumulation of food reserves like protein and carbohydrates which results in higher hundred seed weight after ten months of storage in cowpea seeds as reported by [11].

Germination

The data observed that seed germination was higher with insecticide spray. Pre-harvest spray of spinosad45SC@ 0.04 ml/l recorded higher seed germination of 91.25% followed by emamectin benzoate 5SG @ 0.3 g/l (91.23%), deltamethrin 2.8EC @ 0.04 ml/l (91.21%), as they are on par with each other, lowest recorded in control (82.92%). Spinosad was found effective in maintaining seed quality parameters through foliar application of insecticides leading to lower egg laying and egg hatch which results in higher germination in cowpea seeds as reported in soyabean [11, 12] and in Bengal gram [13].

Seedling vigour index-I

The data showed that seedling vigour index-I was higher with insecticides. Pre-harvest spray of spinosad45SC@ 0.04 ml/l recorded higher seedling vigour index-I of 3728 followed by emamectin benzoate 5SG @ 0.3 g/l (3725), deltamethrin 2.8EC@ 0.04 ml/l(3723), as they are on par with each other, lowest recorded in control (2650). Spinosad was found effective in maintaining seed quality parameters which results in higher seedling vigour index is due to increase in germination and mean seedling length might be due to increase in root and shoot

length which in turn is attributed to the presence of higher amount of stored food material, in cowpea seeds as reported in soyabean [11, 12], in Bengal gram [13] and in green gram [14].

Seedling vigour index-II

The data revealed that seedling vigour index-II was higher with insecticides. Pre- harvest spray of spinosad45SC@ 0.04 ml/l recorded higher seedling vigour index-a!of 6862 followed by emamectin benzoate 5SG @ 0.3 g/l (6858), deltamethrin 2.8EC @ 0.04 ml/l (6856), as they are on par with each other, lowest recorded in control (5472). Spinosad was found effective in maintaining seed quality parameters which results in higher mean seedling dry weight intern results in seedling vigour index-II in soyabean seeds as reported [12] and in Bengal gram [13].

Electrical conductivity

Pre-harvest spray of spinosad45SC@ 0.04 ml/l recorded lower electrical conductivity of239.25 μScm^{-1} followed by emamectin benzoate 5SG @ 0.3 g/l (240.57 μScm^{-1}), deltamethrin 2.8EC @ 0.04 ml/l (241.96 μScm^{-1}), as they are on par with each other, highest recorded in control (346.12μScm^{-1}).Spinosad was found effective in maintaining seed quality parameters which results in decreased electrical conductivity of seed leachates the results are in conformity with the earlier reports in soyabean [15], in green gram [16,17] and in cowpea [18].

Total dehydrogenase activity

The data showed that total dehydrogenase activity was higher with insecticides. Pre- harvest spray of spinosad45SC@ 0.04 ml/l recorded higher total dehydrogenase activity of 2.50 followed by emamectin benzoate 5SG @ 0.3g/l (2.49), deltamethrin 2.8EC @ 0.04 ml/l (2.48), as they are on par with each other. lowest recorded in control (1.73). Spinosad was found effective in maintaining seed quality parameters. TDH activity is taken as a good indicator of degree of aliveness in viable seeds and it enables quick and reliable estimate of vigour. Higher dehydrogenase activity of seeds might be due to high vigorous nature of the seeds. Which results in higher total dehydrogenase activity in cowpea seeds as reported in soyabean [11,12] in Bengal gram [13] and in green gram [14].

Table 1. Influence of pre harvest spray on 100 seed weight (g), germination (%), seedling vigour index-I and seedling vigour index-II in field bean var. HA-4

Treatments	100 Seed weight (g)	Germination (%)	Seedling vigour index-I	Seedling vigour index-II
Control	18.49	82.92	2650	5472
Azadirachtin 10000ppm @ 2.5ml/l	18.98	90.02	3472	6725
Azadirachtin 10000ppm @ 5.0ml/l	19.12	91.13	3700	6839
Deltamethrin 2.8EC @ 0.04ml/l	19.23	91.21	3723	6856
Spinosad 45SC @0.04ml/l	19.30	91.25	3728	6862
Profenophos 50 EC @ 1ml/l	18.83	89.95	3440	6683
Emamectin Benzoate 5SG @ 0.3g/l	19.27	91.23	3725	6858
Moringa leaf powder @ 10 g/l	18.58	87.33	3014	6289
Pongamia oil @ 2ml/l	18.70	88.00	3159	6439
Mean	18.94	89.23	3401	6558
S.Em±	0.45	1.66	84.45	168.9
CD(P=0.05)	1.36	4.94	250.91	501.82
CV (%)	4.29	3.24	4.31	4.47

Seed infestation

The data revealed that seed infestation was lowest with insecticides. Pre-harvest spray of spinosad45SC@ 0.04 ml/l recorded lowest seed infestationof 0.00% followed by emamectin benzoate 5SG @ 0.3g/l (0.00%), deltamethrin 2.8EC @ 0.04 ml/l (0.00%), as they are on par with each other, highest recorded in control (10%).Spinosad was found effective in maintaining seed quality parameters. It could be marked that there was less oviposition in the seed when they were stored for a minimum period of 30 days and consequently there was an increase in the rate of oviposition with the increase in storage periods. Which results in lower seed infestation in soyabean as reported [12], in Bengal gram [13], and in green gram [14].

Number of eggs laid

The data revealed that egg laid was lowest with insecticides.Pre-harvest spray of spinosad45SC@ 0.04 ml/l recorded lowest egg laidof 0.00 followed by emamectinbenzoate 5SG @ 0.3g/l (0.00), deltamethrin 2.8EC @ 0.04 ml/l (0.00), as they are on par with each other, highest recorded in control (113). Spinosad was found effective in maintaining seed quality parameters showed differential level of oviposition rate (Number of eggs laid/ pod) under tested spraying schedules. The application of spinosad at pod maturity stage harboured minimum number of eggs per pod which results in lower seed infestation intern results in lower egg laying in cowpea seeds as reported in soyabean [11,12] and in Bengal gram [13].

Number of eggs hatched

The data revealed that number egg that hatched was lower with insecticides spray. Pre-harvest spray of spinosad45SC@ 0.04 ml/l recorded lower egg hatch of 0.00 followed by emamectin benzoate 5SG @ 0.3g/l (0.00), deltamethrin 2.8EC @ 0.04 ml/l (0.00), as they

Eggs laid **Eggs hatched**

Figure 1. Effect of pre-harvest spray on egg laid, egg hatch in field bean var. HA-4

Table 2. Influence of pre harvest spray on electrical conductivity (μScm^{-1}), total dehydrogenase activity (A_{480nm}),seed infestation (%), number of eggs laid, egg hatch,in field bean var. HA-4

Treatments	Electrical conductivity (μScm^{-1})	Total dehydrogenase activity (A480nm)	Seed infestation (%)	Number of eggs laid	Number of egg hatch
T_1	346.12	1.730	10.00	113	27
T_2	275.27	2.402	0.22	4	1
T_3	259.77	2.462	0.05	1	0.00
T_4	241.96	2.485	0.00	0.00	0.00
T_5	239.25	2.502	0.00	0.00	0.00
T_6	287.35	2.387	0.20	5	1
T_7	240.57	2.499	0.00	0.00	0.00
T_8	318.13	2.108	2.00	26	5
T_9	303.45	2.242	1.50	19	8
Mean	278.73	2.32	1.42	18.66	4.66
S.Em±	5.70	0.057	0.01	0.35	0.08
CD(P=0.05)	16.91	0.171	0.05	1.06	0.23
CV (%)	3.53	4.30	2.40	3.31	3.38

Treatments: T_1: Control; T_2: Azadirachtin 10000ppm @ 2.5ml/l; T_3: Azadirachtin 10000ppm@5.0ml/l; T_4: Deltamethrin 2.8EC @ 0.04ml/l; T_5: Spinosad 45SC @0.04ml/l; T_6: Profenophos 50 EC @ 1ml/l; T_7: Emamectin Benzoate 5SG @ 0.3g/l

are on par with each other, highest recorded in control. Spinosad was found effective in maintaining seed quality parameters showed differential level of oviposition rate (Number of eggs laid/ pod) under tested spraying schedules The application of spinosad at pod maturity stage harboured minimum number of eggs per pod which results in lower seed infestationintern results in lower egg laying and lower egg hatch in cowpea seeds as reported [11] in Bengal gram [13] and in green gram [14].

Thus, spraying of spinosad 45SC @ 0.04 ml/l at pod maturity in field beans was found to be effective for bruchid management during seed storage.

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