Uttar Pradesh Journal of Zoology

Volume 45, Issue 15, Page 372-378, 2024; Article no.UPJOZ.3582
ISSN: 0256-971X (P)

Assessment of Seed Protectants in Respect to Quantitative Losses Due to *Callosobruchus chinensis* Linn in Stored Pigeon Pea

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Authors' contributions

This work was carried out in collaboration among all authors. Author PKS conceived and planned the experiment. Author SP drafting, data analysis, interpretation and revision of the article. Author RBS supervised the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/upjoz/2024/v45i154252

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/3582

Original Research Article

Received: 03/05/2024
Accepted: 07/07/2024
Published: 13/07/2024

ABSTRACT

To test the efficacy of seven tested seed protectants viz., Spinetoram, Flupyradifurone Emamectin benzoate, Deltamethrin, Neem oil, Dry Neem Leaf and Azadirachtin along with control were used against *Callosobruchus chinensis* Linn in stored pigeon pea under ambient condition in Seed Entomology laboratory, ANDUAT, Ayodhya during year 2021-22. All the seed protectants were evaluated for their effectiveness on the basis of seed damage, seed weight and seed moisture against pulse beetle under ambient condition for a period of 2, 4 and 6 months. Among tested seed

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Cite as: *Shukla, P. K., Shweta Patel, R.B. Singh, and S.K.S. Rajput. 2024. "Assessment of Seed Protectants in Respect to Quantitative Losses Due to Callosobruchus Chinensis Linn in Stored Pigeon Pea". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (15):372-78. https://doi.org/10.56557/upjoz/2024/v45i154252.*

protectants the Emamectin benzoate 5 SG followed by Spinetoram 11.7 SC and Neemoz Gold 1EC was found most effective as seed protectants with least seed damage and weight loss of seed up to 6 months of storage.

Keywords: Assessment; Callosobruchus chinensis; seed protectants; Cajanus cajan; loss.

1. INTRODUCTION

Pulses serve as one of the major sources of protein as a “wonderful gift of nature” which play vital role especially in vegetarian diets; these are regarded as “poor man’s meat.” Pulses are third major crops in India after cereals and oilseeds. They have higher levels of protein, dietary fiber and minerals than all the major cereals crops. Pigeon pea [1]. Pigeon pea sustaining livelihood of millions of people due to rich source of protein and increase the soil fertility by biological nitrogen fixation through bacteria [2]. Among the various biotic and abiotic constraints of low productivity, insect pests is one of the major problems. The devastating insect pests which attack pigeon pea at the reproductive phase (flower, buds, pods, and seeds) are pod borer and pod fly while storage, bruchids are the most dangerous.

Fulfilling the need of pulses required the increased of the production of pulses are reduced due to several biotic and in abiotic factors or constraints both in field and storage. Among the storage insect pests, pulse beetle is important insect pests of storage pulse. Upto 8.5 % losses in pulses due to post-harvest handling and storage condition is 8.5 per cent in India [3]. *C. chinensis* is a primary insect pest of pulses, considered to be major and economic pest [4]. Only grub causes damage to stored pulses. The grubs eating out whole internal content of the grain and only the shell is leaved behind. These damaged grains are not useful for consumption of human as well as sowing purpose of pulse crop. In developing countries, pulse production face about 20–25% post-harvest losses due to uses of traditional techniques [5].

Post-harvest losses of pulses are increased every year with an increase in production. Even after numerous technological advancements of storage, we have not been able to under down the losses of pulse seeds due to several biotic stress. Seed protectants are the rapid and effective method for disinfecting and protecting the stored pulses. The use of botanical seed protectants in management of insect pests is considered to be the most viable and ecofriendly safe approach to offset the ever-increasing danger caused by synthetic seed protectants but we could not avoid the instant and rapid effectiveness of synthetic seed protectants for disinfecting and protecting stored pulses from infestation. Hence, there a need to find out effective botanical seed protectants for the eco-friendly management along with new molecules of synthetic seed protectants.

2. MATERIALS AND METHODS

The experiment was conducted in Seed entomology laboratory of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya during 2021-22 in CRD with seven treatments with control with three replications. For the experiments 1 kg of disinfested Pigeon pea seed (NDA-2) was used for each replication of each treatment. For seed treatment, required quantity of seed protectants was mixed in 5ml water to treat 1 kg of pigeon pea seed except dry neem leaf. After treatment seed were packed in 2 kg capacity in jute bag and kept on racks for storage in laboratory under ambient condition. The observations were observed on at 2, 4 and 6 months of storage after seed treatment.

2.1 Per Cent Seed Damage (Insect Infestation)

For damage, randomly selected hundred seeds of each replication along with treatment from experiment were carefully examined through magnifying lens (10x). Healthy and damaged seed were separated on the basis of damage nature of bruchids. The observations were recorded at 2, 4 and 6 months after treatment and calculated by given formula. Mohan and Sundar Babu, [6].

$$\text{Percent seed damage} = \frac{\text{No. of holed seed in sample}}{\text{Total number of seed in sample}} \times 100$$

2.2 Percent Seed Weight Loss

To evaluate the per cent weight loss in pigeon pea, seed was taken from each replication of

treatment, cautiously examined through magnifying lens (10x) to filter out the damaged seed. The observations were recorded at 2,4 & 6 month after treatment. The data obtained was used for calculating seed weight loss per cent by using given formula.

$$\text{Percent weight loss} = \frac{\text{Weight of damaged seed}}{\text{Total weight of seed in sample}} \times 100$$

2.3 Percent Seed Moisture Content

The Per cent Seed moisture contents of pigeon pea seed of each treatment in all three replications were recorded after treatment at 2,4 and 6 months after treatment with the help of moisture meter (MT- PRO™).

3. RESULTS AND DISCUSSION

3.1 Percent Seed Damage (Insect Infestation)

Seed protectants at 4 and 6 months were found significant over untreated, However damage due to pulse beetle was non-significant at 2 months of storage of pigeon pea seed (Table 1).

At two months of storage, the per cent seed damage by pulse beetle ranged 0.33-1.66 per cent within the tested seed protectants. The maximum seed damage was observed in dry neem leaf @ 5gm/kg seed with 1.66 percent followed by Neem oil @ 5 ml/kg seed with 1.33 percent and Neemoz gold 1% EC @ 5 ml/kg seed with 1.00 percent, respectively. However, the minimum seed damage was observed in Emamectin benzoate 5 SG @ 40.0 mg/kg seed and Spinetoram 11.7 SC @ 17mg/kg seed (0.33 %) followed by Flupyradifurone 17.09 SL @ 0.02 ml/kg seed and Deltamethrin 2.8% EC @ 0.04 ml/kg (0.67%) damage, respectively.

At four months of storage, the per cent seed damage by pulse beetle ranged 1.00-2.66 per cent among the tested seed protectants. The highest seed damage was observed in dry neem leaf @ 5gm/kg seed with 2.66 percent followed by Neem oil @ 5 ml/kg seed, Neemoz gold 1% EC @ 5 ml/kg seed and Deltamethrin 2.8% EC @ 0.04 ml/ kg seed with 2.33 percent, respectively. However, the minimum seed damage was observed in Emamectin benzoate 5 SG @ 40.0 mg/kg seed (1 %) followed by Spinetoram 11.7 SC @ 17 mg/kg seed (1.33%) and Flupyradifurone 17.09 SL @ 0.02 ml/kg seed (1.66%), respectively.

At six months of storage, the per cent seed damage by pulse beetle ranged 1.33 -4.66 per cent with in the tested seed protectants. The maximum seed damage was observed in Dry neem leaf @ 5gm/kg seed (4.66 %) followed by Neem oil @ 5 ml/kg seed (3.66%) and Neemoz gold 1% EC @ 5 ml/kg seed (3.33%), respectively. However, the minimum seed damage was observed in Emamectin benzoate 5 SG @ 40.0 mg/kg seed with 1.33 percent followed by Spinetoram 11.7 SC @ 17 mg/kg seed with 2.66 percent and Flupyradifurone 17.09 SL @ 0.02 ml/kg seed and Deltamethrin 2.8% EC @ 0.04 ml/kg seed with 3.00 percent, respectively.

The findings are also by bolstered Singh et al., [7] in mung bean, Kumari et al., [8] in pigeon pea and Singh et al., [9] in pigeon pea.

3.2 Percent Seed Weight Loss

All the seed protectants at 6 months were found superior over control (Table 2). At two months of storage, the per cent seed weight loss ranged from 1.38-5.22 percent within the tested seed protectants. The maximum seed weight loss was observed in Dry neem leaf @ 5gm/kg seed with 5.22 percent followed by Neem oil @ 5 ml/kg seed with 4.86 percent and Neemoz gold 1% EC @ 5 ml/kg seed with 4.56 percent and Deltamethrin 2.8 EC @ 0.04 ml/kg seed with 4.20 percent, respectively. However, the minimum seed weight loss was observed in Emamectin benzoate 5 SG @ 40.0 mg/kg seed (1.38 %) followed by Spinetoram 11.7 SC @ 17 mg/kg seed (2.28 %) and Flupyradifurone 17.09 SL @ 0.02 ml /kg seed (3.93 %), respectively.

At four months of storage, the per cent seed weight loss ranged from 2.93-8.32 per cent with in the tested seed protectants. The highest seed weight loss was observed in Dry neem leaf @ 5gm/kg seed (8.32%) followed by Neem oil @ 5 ml/kg seed (7.26 %) and Neemoz gold 1% EC @ 5 ml /kg seed (6.60%), Deltamethrin 2.8% EC @ 0.04 ml/kg seed (4.86 %), respectively. However, the lowest seed weight loss was observed in Emamectin benzoate 5SG @ 40.0 mg/ kg seed with 2.93 percent followed by Spinetoram 11.7SC @ 17 mg/kg seed with 3.90 percent and Flupyradifurone 17.09SL @ 0.02 ml/kg seed with 4.36 percent, respectively.

At six months of storage, the per cent seed weight loss ranged from 5.67-11.20 percent within the tested seed protectants. The maximum

seed weight loss observed in Dry neem Leaf @ 5gm/kg seed with 11.20 percent followed by Neem oil @ 5 ml / kg seed with 10.51 percent, Neemoz gold 1% EC @ 5 ml/ kg seed with 9.59 percent, Flupyradifurone 17.09 SL @ 0.02 ml/kg seed with 6.74 percent, Deltamethrin 2.8% EC @ 0.04 ml/kg seed with 6.00 percent, respectively. However, the lowest seed weight loss was observed in Emamectin benzoate 5 SG @ 40.0 mg/kg seed (4.82%) followed by Spinetoram 11.7 SC @ 17 mg/kg seed (5.67%) and Deltamethrin 2.8% EC @ 0.04 ml /kg seed (6%), respectively.

Table 1. Evaluation of seed protectants on per cent seed damage in pigeon pea *C. chinensis* (L.) at various storage periods during 2021-22

Treatments	Seed protectants		Dose / kg Seed	Insect Damage (%) Month After Treatment (MAT)		
	Common name	Trade name		2 Month	4 Month	6 Month
T_1	Spinetoram	Delegate 11.7 C	17mg	0.33 (1.91)	1.33 (6.53)	2.66 (9.35)
T_2	Flupyradifurone	Sivanto prime 17.09 SL	0.02ml	0.67 (3.82)	1.66 (7.33)	3.00 (9.97)
T_3	Emamectin benzoate	EM-1 5 SG	40.0mg	0.33 (1.91)	1.00 (5.73)	1.33 (6.53)
T_4	Neem Oil	-	5ml	1.33 (6.53)	2.33 (8.74)	3.66 (11.01)
T_5	Dry Neem Leaf	-	5gm	1.66 (7.33)	2.66 (9.35)	4.66 (12.45)
T_6	Azadirachtin	Neemoz gold 1% EC	5ml	1.00 (5.73)	2,33 (8.74)	3.33 (10.49)
T_7	Deltamethrin	Decis 2.8% EC	0.04ml	0.67 (3.82)	2.33 (8.74)	3.00 (9.97)
T_8	Control			1.67 (7.33)	4.66 (12.45)	7.66 (16.06)
SEm ±				1.43	0.61	0.48
CD at 5%				N/S	1.84	1.47

**Figures in the parenthesis are arcsine transformed values*

Table 2. Evaluation of seed protectants on per cent weight loss in pigeon pea seed by *C. chinensis* (L.) at various storage periods during 2021-22

Treatments	Seed protectants		Dose / kg Seed	Seed weight loss (%) Month After Treatment (MAT)		
	Common name	Trade name		At 2 Month	At 4 Month	At 6 Month
T_1	Spinetoram	Delegate11.7 SC	17mg	2.28 (8.67)	3.90 (11.37)	5.67 (13.76)
T_2	Flupyradifurone	Sivanto prime 17.09 SL	0.02ml	3.93 (11.42)	4.36 (12.04)	6.74 (15.03)
T_3	Emamectin benzoate	EM-1 5 SG	40.0mg	1.38 (6.72)	2.93 (9.83)	4.82 (12.67)
T_4	Neem Oil	_	5ml	4.86 (12.69)	7.26 (15.61)	10.51 (18.89)
T_5	Dry Neem Leaf	_	5gm	5.22 (13.19)	8.32 (16.75)	11.20 (19.54)
T_6	Azadirachtin	Neemoz gold 1% EC	5ml	4.56 (12.32)	6.60 (14.87)	9.59 (18.03)
T_7	Deltamethrin	Decis 2.8 % EC	0.04ml	4.20 (11.81)	4.86 (12.72)	6.00 (14.17)
T_8	Control			9.73 (18.16)	12.08 (20.32)	17.33 (24.59)
SEm ±				0.36	0.29	0.29
CD at 5%				1.10	0.89	0.88

**Figures in the parenthesis are arcsine transformed value*

These findings are accordance with Singh et al*.,* [7] in mung bean, Kumari et al*.,* [8] Sahu et al*.,* [10] Das et al*.,* [11] and Singh et al., [9] in pigeon pea.

3.3 Percent Seed Moisture Content

The figures related to moisture content of seed affected by seed protectants, storage period as well as storage condition (Table 3). Percent seed moisture content regarding effect of seed treatments was found compelling according to nature of seed protectants and the time of storage period. All the seed protectants at four and sixth months of storage were found remarkable superior over control. However, percent seed moisture content was non-significant at two months of storage. At two months of storage, the per cent seed moisture content ranged from 11.0 – 12.75 percent. The highest seed moisture content was observed with in Dry neem leaf @ 5gm/kg seed (12.75%) followed by Neem oil @ 5 ml/kg seed (12.60 %), Neemoz Gold 1% EC @ 5 ml/kg seed (12.50%), Deltamethrin 2.8% EC @ 0.04 ml/ kg seed (12.30%), respectively. However, the lowest seed moisture content was observed in Emamectin benzoate 5 SG @ 40.0 mg/kg seed with 11.0 percent followed by Spinetoram 11.7 SC @ 17 mg/ kg seed with 11.90 percent and Flupyradifurone 17.09 SL @ 0.02 ml/ kg seed with 12.10 percent, respectively. At four months of storage, the percent seed moisture content ranged from 12.10- 13.20 per cent within the tested seed protectants. The maximum seed moisture content was observed within Dry neem leaf @ 5gm/kg seed (13.20%) followed by Neem oil @ 5 ml/kg seed (12.95%), Neemoz gold 1% EC @ 5 ml/ kg seed (12.70%), Deltamethrin 2.8% EC @ 0.04 ml/kg seed (12.50%), respectively. However, the minimum seed moisture content observed in Emamectin benzoate 5 SG @ 40.0 mg/ kg seed with 12.10 percent followed by Spinetoram 11.7 SC @ 17 mg/kg seed with 12.26 percent and Flupyradifurone 17.09 SL @ 0.02 ml/ kg seed with 12.30 per cent, respectively.

At six months of storage, the per cent seed moisture content ranged from 13.20- 14.30 per cent among the tested seed protectants. The maximum seed moisture content was noted in Dry neem leaf @ 5gm/ kg seed with 14.30 percent followed by Neem oil @ 5 ml/ kg seed with 14.01 percent, Neemoz gold 1% EC @ 5 ml/ kg seed with 13.90 percent and Deltamethrin 2.8% EC @ 0.04 ml/ kg seed with 13.80 percent, respectively. However, the minimum seed moisture content noticed in Emamectin benzoate 5 SG @ 40.0 mg/kg seed (13.20%) followed by Spinetoram 11.7 SC @ 17 mg/ kg seed (13.32%)

Table 3. Efficacy of seed protectants on seed moisture content of pigeon pea seed at various storage periods during 2021-22

Treatments	Seed protectants		Dose / kg Seed	Seed Moisture Content (%) Month After Treatment (MAT)		
	Common name	Trade name		At two Months	At four Months	At six Months
T_1	Spinetoram	Delegate11.7 SC	17mg	11.90 (20.16)	12.26 (20.48)	13.32 (21.39)
T_2	Flupyradifurone	Sivanto prime 17.09 SL	0.02ml	12.10 (20.33)	12.30 (20.52)	13.40 (21.46)
T_3	Emamectin benzoate	EM-1 5 SG	40.0mg	11.00 (19.36)	12.10 (20.34)	13.20 (21.29)
T_4	Neem Oil	_	5ml	12.60 (20.77)	12.95 (21.08)	14.01 (21.97)
T_5	Dry Neem Leaf	_	5gm	12.75 (20.90)	13.20 (21.29)	14.30 (22.20)
T_6	Azadirachtin	Neemoz gold 1% EC	5ml	12.50 (20.69)	12.70 (20.86)	13.90 (21.88)
T_7	Deltamethrin	Decis 2.8 % EC	0.04ml	12.30 (20.50)	12.50 (20.69)	13.80 (21.79)
T_8	Control			13.10 (21.21)	13.30 (21.37)	14.40 (22.29)
SEm ±				0.39	0.17	0.14
CD at 5%				N/S	0.51	0.44

**Figures in the parenthesis are arcsine transformed values*

and Flupyradifurone 17.09 SL @ 0.02 ml/kg seed (13.40%), respectively. The findings are similar to Yadav et al., [12] and Singh et al., [9] in pigeon pea. The results revealed that per cent seed damage, weight loss and seed moisture of pigeon pea seed was proportionate to storage period [13].

4. CONCLUSION

There was significant difference among all the seed protectants over control on the basis quality parameters of seed. Based on above experiment, Emamectin benzoate 5 SG @ 40.0 mg /kg seed followed by Spinetoram 11.7 SC @ 17 mg/ kg seed and Neemoz Gold 1% EC @ 5 ml/kg seed may be used as suitable seed protectants for protecting the seed of pigeon pea seed against pulse beetle infestation under ambient storage condition to maintain the Indian Minimum Seed Certification Standards (IMSCS) level upto six months.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ACKNOWLEDGEMENT

We gratefully acknowledge the ANDUA&T, Ayodhya for providing facilities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/3582