Effect of pre-harvest sprays of insecticides/botanicals for control of pulse beetle infestation and seed weight loss in mung bean during storage

Abstract

Field-cum-laboratory experiment was conducted to study the effect of pre-harvest spray of insecticides and botanicals for control of pulse beetle in mung bean at Seed Technology Research Unit, Mahatma Phule Krishi Vidyapeeth, Rahuri, during *Kharif* 2020 and summer 2021 with four treatments of pre-harvest spray of insecticides and botanicals and two genotypes of mung bean (Phule Vaibhav and BM 2003-2). The results noticed that pulse beetle infestation and seed weight loss differed significantly due to pre-harvest spray of insecticides. The lowest number of pulse beetle infestation (%)and seed weight loss (%) were recorded in treatment Emamectine Benzoate@ 0.3 ml/L followed by Neemazal 10000 ppm @ 4 ml/L. In the case of genotypes, a lower number of Pulse beetle infestation and seed weight loss was recorded in Phule Vaibhav as compared to BM 2003-2. Among the interaction effect significant lowest pulse beetle infestation, as well as seed weight loss, was observed with pre-harvest spraying of Emamectine Benzoate@ 0.3 ml/L in Phule Vaibhav to check the infestation of pulse beetle during storage up to 270 days.

Keywords: Pre-harvest spray, insecticides, mung bean and *Callosobruchus chinensis*

1. Introduction

Pulses play a significant role in the diet of the Indian people. Undoubtedly, pulses are an important protein source for vegetarians and it is also considered poor man's meat for underprivileged people who cannot afford animal proteins (Rahman *et al*., 2013). Among the pulse crop, one of the most economical pulse products is the mung bean (*Vigna radiata* L. Wilczek). It complements Asia's traditional diet of rice and wheat and is a wonderful source of readily absorbed protein that is also low in flatulence. When combined with other nutrients, cereals offer an ideal balance of biologically important necessary amino acids.

Callosobruchus chinensis L., the most dangerous insect pest in pulses, is known to be prolific and rapid in breeding, and can swiftly cause a significant quantitative drop as well as diminish the nutritional value of stored grains. The adult pulse beetles do not eat the seeds but they mate and oviposit on them. The newly hatched larva bores into the seed and starts feeding on its contents till the whole endosperm are eaten up. The damage due to this pest affects the germinating ability and nutritive value of the seed (Sharma, 1984).

During storage, the beetles can cause up to 100 per cent loss in bean seeds. (Gbaye *et al*, 2011). Pulse beetles feed on the endosperm of seed leaving behind only the seed coat causing a reduction in the germination of seeds, weight loss and lower market value (Tesfu and Emana, 2013). An effort was undertaken to evaluate the seed damage, weight loss, and germination loss in a local mung bean variety during storage in light of the economic significance of pulses as well as losses brought on by the pulse beetle.

During storage, *Callosobruchus spp.* can ruin pulse seeds completely. In temperate areas, damage from pulse beetles during storage may account for 5-10 per cent of the crop, while it may be 20–30 per cent in tropical nations (Gbaye *et al*., 2011). Losses brought on by *C. maculates* in pulses have been calculated between 30 and 40%. (Poornasundari and Daniel, 2015).

Several pesticides as well as botanicals are used to manage pulse beetles to prevent the qualitative and quantitative losses brought on by bruchid infestation. As a first step toward producing seed free of insects, experiments will also be started with green gram to assess the impact of pre-harvest sanitation sprays on bruchid infestation and seed quality traits of the resulting seeds.

Material and methods

The field trial was conducted at Post Graduate Institute Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, during the year *Kharif* 2020 and *summer* 2021 with two genotypes of mung bean (Phule Vaibhav and BM 2003-2). Adopting Factorial Randomized Block Design in Field and Factorial Complete Randomized Design in Laboratory. A crop was raised after following recommended agronomical practices under irrigated conditions. The preharvest insecticides/botanicals spray was given at 50% pod formation and maturity stage of the crop growth. The crop was imposed with pre-harvest spray using Neemazal T/S 10000 ppm @ 2 ml/L (T_1), Neemazal T/S 10000 ppm @ 4 ml/L (T_2) and Emamectin benzoate @ 0.3 ml/L (T_3) with knapsack sprayer as prophylactic measures against pulse beetle. The unsprayed plots served as control (T_4).

Preharvest sprayed 100 gm seed was kept in a bottle container and 10 pair pulse beetle was released in the plastic bottles, pulse beetle infestation (%) and seed weight loss (%) was recorded at 90 days interval to check the bio-efficacy of preharvest sprayed insecticides/botanicals against pulse beetle *Callosobruchus chinensis* in mung bean.

Results and Discussion

Pulse beetle infestation (%)

The data of pulse beetle infestation (%) as influenced by preharvest spraying of insecticides/botanicals, varieties and their interactions are presented in Table 1 cent seed infestation was recorded for 90 DAS, 180 DAS and 270 DAS periods.

Effect of preharvest spraying of insecticides/botanicals

In *Kharif* 2020 season, lowest pulse beetle infestation was recorded in the preharvest sprayed seed with emetine benzoate @ 0.3 ml/L of water (T_3) 0.00 (%), 0.05 (%) and 0.52 (%) followed by neemazal @ 4 ml/L of water (T_2) 0.00%, 0.65% and 4.71% at 90, 180 and 270 days of storage period respectively. The highest pulse beetle infestation was recorded in the control (T_4) 3.45 (%) 10.29 (%) and 23.97 (%) at 90, 180 and 270 days of storage period respectively.

In *summer* 2021 lowest pulse beetle infestation was recorded in the preharvest sprayed seed with emamectine benzoate @ 0.3 ml/L of water (T_3) 0.00 (%), 0.04 (%) 0.22 (%) and followed by neemazal @ 4 ml/L of water (T_2) 0.00%, 0.59% and 4.17% at 90, 180 and 270 days of storage period respectively. The highest pulse beetle infestation was recorded in the control (T_4) at 3.05 (%), 9.88 (%) and 23.84 (%) at 90, 180 and 270 days of storage period respectively.

Effect of varieties

From the data, it was observed that there were significant differences in pulse beetle infestation (%) due to the varieties during both seasons.

In *Kharif* 2020 season, lowest pulse beetle infestation was recorded for the variety Phule Vaibhav (V_1) 0.78 (%), 3.10 (%) and 9.10 (%) whereas highest pulse beetle infestation was recorded in the BM 2003-2 (V_2) 0.95(%), 3.34(%) and 9.77(%) at 90, 180 and 270 days of storage period respectively.

In summer 2021 season, lowest pulse beetle infestation was recorded for the variety Phule Vaibhav (V_1) 0.71 (%), 2.86 (%) and 8.83 (%) whereas highest pulse beetle infestation was recorded in the BM 2003-2 (V_2) 0.81(%), 3.08(%) and 9.26(%) at 90, 180 and 270 days of storage period respectively.

Interaction effect of preharvest spraying of insecticides/botanicals treatments and varieties

From the data, it was found that the interaction effects of preharvest spraying of insecticides/botanicals treatments and varieties on pulse beetle infestation (%) of mung bean was significant during both seasons.

In the *kharif* 2020 season, the lowest pulse beetle infestation was recorded in the interaction T_3V_1 0.00 (%), 0.00 (%) and 0.35(%) followed by interaction T_3V_2 0.00(%), 0.10(%) and 0.69(%) at 90, 180 and 270 days of storage period respectively. The highest pulse beetle infestation was recorded in the interaction T_4V_2 3.79 (%) 10.62(%) and 24.64(%) at 90, 180 and 270 days of storage period respectively.

In the *summer* 2021 season, the lowest pulse beetle infestation was recorded in the interaction T_3V_1 0.00 (%), 0.00 (%) and 0.14(%) followed by interaction T_3V_2 0.00(%), 0.08(%) and 0.30(%) at 90, 180 and 270 days of storage period respectively. The highest pulse beetle infestation was recorded in the interaction T_4V_2 3.25 (%) 10.31(%) and 24.12(%) at 90, 180 and 270 days of storage period respectively.

The findings match previous research by Kumar *et al*. (2016) evaluated different plant-based essential oils for their deterrent effect on oviposition, adult emergence and seed damage caused by *C. chinensis* in mung beans. Among different oils, neem oil @ 2.5 ml/kg seeds was found to be most effective against *C. chinensis.* Further, Chaudhary *et al.* (2017) found that % infested grains after three months was significantly maximum (99.0%) in mung bean.

Seed weight loss (%)

The data of seed weight loss (%) are presented in Table 2 seed weight loss was recorded for 90 DAS, 180 DAS and 270 DAS periods.

Effect of preharvest spraying of insecticides/botanicals

In *Kharif* 2020 season, lowest pulse seed weight loss was recorded in the preharvest sprayed seed with emetine benzoate @ 0.3 ml/L of water (T_3) 0.00 (%), 0.03 (%) and 0.47 (%) followed by neemazal @ 4 ml/L of water (T_2) 0.00(%), 0.58(%) and 2.00(%) at 90, 180 and 270 days of storage period respectively. Highest seed weight loss was recorded in the control (T_4) 3.46 (%) 8.25 (%) and 15.10 (%) at 90, 180 and 270 days of storage period respectively.

In summer 2021 lowest seed weight loss was recorded in the preharvest sprayed seed with emetine benzoate @ 0.3 ml/L of water (T_3) 0.00 (%), 0.00 (%) 0.34 (%) and followed by neemazal @ 4 ml/L of water (T_2) 0.00%, 0.46% and 1.80% at 90, 180 and 270 days of storage period respectively. The highest seed weight loss was recorded in the control (T_4) at 3.25 (%), 7.94 (%) and 14.66 (%) at 90, 180 and 270 days of storage period respectively.

Effect of varities From the data, it was observed that there were significant differences in seed weight loss (%) due to the varieties during both seasons.

In the *Kharif* 2020 season, the lowest seed weight loss was recorded for the variety Phule Vaibhav (V_1) 0.82 (%), 2.54 (%) and 6.30 (%) whereas the highest seed weight loss was recorded in the BM 2003-2 (V_2) 0.91(%), 2.75(%) and 6.76(%) at 90, 180 and 270 days of storage period respectively.

In the summer 2021 season, lowest seed weight loss was recorded for the variety Phule Vaibhav (V_1) 0.78 (%), 2.30 (%) and 5.93 (%) whereas highest seed weight loss was recorded in the BM 2003-2 (V_2) 0.85(%), 2.61(%) and 6.41(%) at 90, 180 and 270 days of storage period respectively.

Interaction effect of preharvest spraying of insecticides/botanicals treatments and varieties

From the data, it was found that the interaction effects of preharvest spraying of insecticides/botanicals treatments and varieties on seed weight loss (%) of mung bean were significant during both seasons.

In the *Kharif* 2020 season, the lowest seed weight loss was recorded in the interaction T_3V_1 0.00 (%), 0.00 (%) and 0.21(%) followed by interaction T_3V_2 0.00(%), 0.05(%) and 0.72(%) at 90, 180 and 270 days of storage period respectively. The highest seed weight loss was recorded in the interaction T_4V_2 3.63 (%) 8.45(%) and 15.33(%) at 90, 180 and 270 days of storage period respectively.

In the summer 2021 season, the lowest seed weight loss was recorded in the interaction T_3V_1 0.00 (%), 0.00 (%) and 0.11(%) followed by interaction T_3V_2 0.00(%), 0.00(%) and 0.58(%) at 90, 180 and 270 days of storage period respectively. The highest seed weight loss was recorded in the interaction T_4V_2 3.39 (%) 8.28(%) and 14.97(%) at 90, 180 and 270 days of storage period respectively.

The current findings are similarly consistent with those of Hasan *et al.* (2021) who demonstrated the efficacy of biorational insecticides on weight loss of seeds of pulse beetle, *Callosobruchus chinensis* under laboratory conditions. Also, the results in agreement with Ashok *et al.* (2020) showed that all the treatments were significantly superior over untreated control. Minimum per cent infestation and percent weight loss were noted in Deltamethrin (2.8 EC) 0.04 ml/ 100 seeds followed by Nimbicidin 5 ml/ 100 seeds and maximum was seen in the untreated control.

Conclusions

Among the different treatments, spraying of Emamectine benzoate @ 0.3 ml/L of water followed by Neemazal 10000 ppm @ 4 ml/L of water for the variety Phule Vaibhav was found more effective for checking cross infestation of pulse beetle in mung bean in both the seasons and also recorded with lowest pulse beetle infestation and lowest seed weight loss.

Table 1. Effect of preharvest treatments, varieties and their interactions on pulse beetle infestation (%) of green gram during storage.

Pulse beetle infestation (%)						
	90 DAS		**180 DAS**		**270 DAS**	
Treatments (T)	***Kharif* 2020**	***Summer* 2021**	***Kharif* 2020**	***Summer* 2021**	***Kharif* 2020**	***Summer* 2021**
T_1= Neemazal @ 2 ml/L	0.00 (0.00)	0.00 (0.00)	1.70 (7.48)	1.37 (6.70)	8.52 (16.97)	7.95 (16.38)
T_2= Neemazal @ 4 ml/L	0.00 (0.00)	0.00 (0.00)	0.65 (4.58)	0.59 (4.39)	4.71 (12.54)	4.17 (11.78)
T_3= Emamectine Benzoate@ 0.3 ml/L	0.00 (0.00)	0.00 (0.00)	0.05 (0.91)	0.04 (0.81)	0.52 (4.08)	0.22 (2.65)
T_4= Control	3.45 (10.68)	3.05 (10.05)	10.29 (18.70)	9.88 (18.32)	23.97 (29.31)	23.84 (29.22)
SEm (±)	0.020	0.027	0.045	0.057	0.017	0.047
CD at 5%	0.059	0.082	0.135	0.171	0.051	0.141
CD at 1%	0.082	0.113	0.186	0.235	0.071	0.194
Varieties (V)						
V_1= Phule Vaibhav	0.78 (2.54)	0.71 (2.43)	3.10 (7.41)	2.86 (7.24)	9.10 (15.29)	8.83 (14.68)
V_2= BM 2003-2	0.95 (2.81)	0.81 (2.60)	3.34 (8.42)	3.08 (7.87)	9.77 (16.16)	9.26 (15.33)
SEm (±)	0.014	0.019	0.032	0.040	0.012	0.033
CD at 5%	0.042	0.058	0.095	0.121	0.036	0.100
CD at 1%	0.058	0.080	0.131	0.166	0.050	0.137
Variety × Treatment interaction (V×T)						
T_1V_1	0.00 (0.00)	0.00 (0.00)	1.56 (7.17)	1.50 (7.03)	8.31 (16.75)	7.75 (16.16)
T_1V_2	0.00 (0.00)	0.00 (0.00)	1.84 (7.79)	1.23 (6.37)	8.74 (17.20)	8.15 (16.59)
T_2V_1	0.00 (0.00)	0.00 (0.00)	0.51 (4.10)	0.49 (4.01)	4.44 (12.16)	3.89 (11.38)
T_2V_2	0.00 (0.00)	0.00 (0.00)	0.78 (5.07)	0.69 (4.76)	4.99 (12.91)	4.44 (12.17)
T_3V_1	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.35 (3.39)	0.14 (2.15)
T_3V_2	0.00	0.00	0.10	0.08	0.69	0.30

	(0.00)	(0.00)	(1.81)	(1.62)	(4.76)	(3.14)
T_4V_1	3.10 (10.14)	2.85 (9.72)	9.95 (18.39)	9.45 (17.90)	23.29 (28.86)	23.55 (29.03)
T_4V_2	3.79 (11.23)	3.25 (10.39)	10.62 (19.02)	10.31 (18.73)	24.64 (29.76)	24.12 (29.42)
SEm (±)	0.028	0.039	0.064	0.081	0.024	0.066
CD at 5%	0.084	0.116	0.191	0.242	0.073	0.199
CD at 1%	0.115	0.159	0.263	0.333	0.100	0.274

*Figure in parenthesis indicates arcsine transformed value DAS:- Days After Storage

Table 2. Effect of preharvest treatments, varieties and their interactions on seed weight loss (%) of green gram during storage.

Seed weight loss (%)						
	90 DAS		**180 DAS**		**270 DAS**	
Treatments (T)	***Kharif* 2020**	***Summer* 2021**	***Kharif* 2020**	***Summer* 2021**	***Kharif* 2020**	***Summer* 2021**
T_1= Neemazal @ 2 ml/L	0.00 (0.00)	0.00 (0.00)	1.73 (7.55)	1.43 (6.85)	8.58 (17.02)	7.89 (16.31)
T_2= Neemazal @ 4 ml/L	0.00 (0.00)	0.00 (0.00)	0.58 (4.30)	0.46 (3.83)	2.00 (8.12)	1.80 (7.70)
T_3= Emamectine Benzoate@ 0.3 ml/L	0.00 (0.00)	0.00 (0.00)	0.03 (0.64)	0.00 (0.00)	0.47 (3.75)	0.34 (3.12)
T_4 = Control	3.46 (10.71)	3.25 (10.37)	8.25 (16.69)	7.94 (16.36)	15.10 (22.86)	14.66 (22.51)
SEm (±)	0.020	0.028	0.049	0.051	0.042	0.035
CD at 5%	0.060	0.085	0.148	0.153	0.127	0.104
CD at 1%	0.083	0.118	0.203	0.211	0.175	0.144
Varieties (V)						
V_1=Phule Vaibhav	0.82 (2.61)	0.78 (2.53)	2.54 (6.89)	2.30 (6.42)	6.30 (12.47)	5.93 (11.87)
V_2= BM 2003-2	0.91 (2.75)	0.85 (2.65)	2.75 (7.70)	2.61 (7.10)	6.76 (13.40)	6.41 (12.95)
SEm (±)	0.014	0.020	0.035	0.036	0.030	0.025
CD at 5%	0.043	0.060	0.104	0.108	0.090	0.074
CD at 1%	0.059	0.083	0.144	0.149	0.124	0.102
Treatment X Variety Interaction (T X V)						
T_1V_1	0.00 (0.00)	0.00 (0.00)	1.72 (7.54)	1.30 (6.55)	8.25 (16.69)	7.68 (16.09)
T_1V_2	0.00 (0.00)	0.00 (0.00)	1.73 (7.56)	1.55 (7.15)	8.90 (17.36)	8.09 (16.53)
T_2V_1	0.00 (0.00)	0.00 (0.00)	0.38 (3.53)	0.30 (3.14)	1.89 (7.90)	1.60 (7.27)
T_2V_2	0.00 (0.00)	0.00 (0.00)	0.78 (5.07)	0.62 (4.52)	2.10 (8.33)	2.00 (8.13)

T_3V_1	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.21 (2.63)	0.11 (1.87)
T_3V_2	0.00 (0.00)	0.00 (0.00)	0.05 (1.28)	0.00 (0.00)	0.72 (4.87)	0.58 (4.36)
T_4V_1	3.28 (10.43)	3.10 (10.14)	8.05 (16.48)	7.60 (16.00)	14.86 (22.67)	14.34 (22.26)
T_4V_2	3.63 (10.98)	3.39 (10.61)	8.45 (16.90)	8.28 (16.72)	15.33 (23.05)	14.97 (22.77)
SEm (±)	0.028	0.040	0.070	0.072	0.060	0.049
CD at 5%	0.085	0.121	0.209	0.216	0.179	0.147
CD at 1%	0.117	0.166	0.288	0.298	0.247	0.203

*Figure in parenthesis indicates arcsine transformed value DAS:- Days After Storage

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