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Evaluation of pre-harvest spraying of insecticides for management of pulse beetle (*Callosobruchus* Sp.) in green gram

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Abstract
Field-cum-laboratory experiment was conducted to study the effect of pre-harvest spraying of insecticides for control of pulse beetle (*Callosobruchus* Sp.) in green gram at Seed Technology Research Unit, Main Pearl Millet Research Station, J.A.U., Jamnagar during *Kharif* 2015-16 to 2018-19. The experiment was laid out in the randomized block design consisted of 13 treatment combinations involving three replications. Number of exit holes of pulse beetle differed significantly due to pre-harvest spray of insecticides and different spraying schedules. The lowest number of exit holes of pulse beetle were recorded in treatment Profenofos 50 EC @1ml/L (0.67), spraying at 50% & 100% pod maturity followed by spraying Emamectin benzoate 5SG @ 0.3g/L (3.91) at 50% & 100% pod maturity at two months of storage.

Keywords: Green gram, pulse beetle (*Callosobruchus chinensis* L.), seed damage, management

Introduction
Green gram (*Vigna radiata* (L) Wilczek) is under cultivation since prehistoric time in India. It is quite versatile crop grown for seeds, green manure and forage and it is also considered as "Golden Bean" because of its nutritive values and suitability for increasing the soil fertility by the way of addition of nitrogen to the soil. Among the storage pests, bruchids is cur greater importance. Among the bruchids, pulses beetles *C. maculatus*, *C. chinensis*, *C. phaseoli*, *C. theobromae* and *C. analis* are major pests causing serious damage and are cosmopolitan in distribution. Pulses suffer losses both qualitatively and quantitatively by this pest due to this habit [5]. In storage, totally 25 species of insects have been recorded on pulses. Of these, coleopteran causes major damage to stored grains and its products. Among these, the pulse beetles *Callosobruchus* spp. is the major pests in stored pulse [2] causes 40-50% losses in pulses storage [4] and causes 24-25% in germination [9]. The losses in pulses during post harvest handling and storing has been estimated about 8.5 per cent in India and recorded zero percent germination due to *C. chinensis* infestation after six months in stored green gram. Among the eight legumes, the highest seed damage (79.59%) caused by *C. chinensis* was reported in green gram followed by black gram (59.30%), cow pea (51.04%), white gram (29.98%) and pea (1.70%) [7]. The beetle completes its life cycle within 25 to 34 days during summer, while 40 to 50 days in winter [4] but in the presence of grain protectants, life of the beetle found to be disturbed [1]. Infestation starts right from the field and continues to the store [3]. At last stage of maturation, seeds are infested by bruchids either from field or by the bruchids migrating from infested seeds of adjacent granaries or from seed godown which do not have expression at field [10]. As per the ancient adage, "Prevention is better than cure", controlling these pests in the field prevents them from entering godowns and spreading further to uninfected seeds. The marginal and sub-marginal farmers are unable to fumigate their godowns as most of the farmers used to store their produce in the gunny bags or in rooms where they are also receiving. It is very difficult to manage the pulse beetle which causes heavy losses during storage. Under such situation, it is necessary to find out such strategy which will be helpful to manage the pest. Accordingly to damaging pattern of this pest (Infestation starts right from the field) pre-harvest sanitation spray is a novel method to arrest these pathogens / insects in the field itself thereby delimiting the damage during storage. It involves the spraying of fungicides and / or insecticides during the formation and development of pod and seed at needy concentrations at suitable intervals [11].

Materials and Methods

In field

The field trials were conducted during *kharif*-2015 to 2018 at Seed Technology Research Unit, Main Pearl Millet Research Station, J.A.U., Jamnagar with green gram (variety: Green Gram & GM-4) adopting Randomized Block Design with three replications. A seed crop was raised after following recommended agronomical practices in a plot size 5 x 3 m^2 under irrigated condition. Insecticidal spray was applied as per the three spraying schedules i.e. spraying at 50% pod maturity (S_1), spraying at 100% maturity (S_2) and spraying at 50% pod maturity and 100% pod maturity (S_3). Insecticidal spray were applied as per the treatments. The crop was imposed with pre-harvest spray Emamectin benzoate 5SG 0.3g/L, Malathion dust 5% 10kg/acre, Profenofos 50 EC 1ml/L and Neemazal 10000 ppm 1ml/L with knapsack sprayer as prophylactic measures against pulse beetle. The unsprayed plots served as control.

In storage

After threshing, 500 g seed was collected from each treatment, replication-wise. Such quantity of seed was kept in cloth bag ensuring protection from cross infestation during the storage period. The observations on number of exit holes were recorded at weekly interval up to two month. For the purpose, 100 seeds were randomly selected from each treatment replication-wise and seeds having exit hole were counted. The data recorded on number of exit hole was subjected to ANOVA.

Results and Discussion

During the first year data on number of exit holes in pre-harvest spraying of different insecticides as per treatment was showed least number of exit holes were recorded in T9 (0.27 holes/500 g seeds). However, it was at par with T_8 (1.87 holes/500 g seeds). Whereas, during *Kharif* 2016, in treatment number T_3, T_8 & T_9 there were no exit holes in green gram seeds stored. However, it was at par with T_1 (4.98 holes/500g seeds). In *Kharif* 2017 in treatment number T_3, T_8 & T_9 there were no exit holes in green gram seeds stored. During *Kharif* 2018, T_3 recorded least number of exit holes (1.93/500g seeds). The pooled data of four years revealed that least number of exit holes were recorded in T_9 (0.67 holes/500 g seeds). However, it was at par with T_8 (5.12 holes/500 g seeds), T_1 (10.66 holes/500 g seeds) & T_3 (3.91 holes/500 g seeds). These findings are in agreement with pre-harvest spray of different insecticides malathion [12] and Indoxacarb [6] in green gram. The reduction of damaged seed percentage in the sprayed plots due to their insecticidal property was also supported by in mungbean [13] and in peas [8].

Table 1: Effect of pre-harvest spraying of insecticides on number of exit holes of pulse beetle at 2 months of storage period in green gram

No.	Treatments		Number of exit holes at 2 months			
		2015	2016	2017	2018	Pooled
1	Emamectin benzoate 5SG @ 0.3g/L, spraying at 50% pod maturity	5.98* (35.26)	2.34* (4.98)	2.45* (5.50)	2.61* (6.31)	3.34* (10.66)
2	Emamectin benzoate 5SG @ 0.3g/L, spraying at 100% pod maturity	5.67 (31.65)	7.90 (61.91)	8.24 (67.70)	2.26 (4.61)	6.02 (35.74)
3	Emamectin benzoate 5SG @ 0.3g/L, spraying at 50% & 100% pod maturity	5.42 (28.88)	0.71 (0.00)	0.71 (0.00)	1.56 (1.93)	2.10 (3.91)
4	Malathion dust 5% @10kg/acre spraying at 50% pod maturity	5.15 (26.02)	4.61 (20.75)	5.07 (25.20)	9.36 (87.11)	6.05 (36.10)
5	Malathion dust 5% @10kg/acre spraying at 100% pod maturity	4.94 (23.90)	8.20 (66.74)	7.37 (53.82)	8.63 (73.98)	7.29 (52.64)
6	Malathion dust 5% @10kg/acre spraying at 50% & 100% pod maturity	4.91 (23.61)	10.69 (113.78)	2.84 (7.57)	5.80 (33.14)	6.06 (36.22)
7	Profenofos 50 EC @1ml/L spraying at 50% pod maturity	3.17 (9.55)	16.53 (272.74)	6.84 (46.29)	7.13 (50.34)	8.42 (70.40)
8	Profenofos 50 EC @1ml/L spraying at100% pod maturity	1.54 (1.87)	0.71 (0.00)	0.71 (0.00)	6.52 (42.01)	2.37 (5.12)
9	Profenofos 50 EC @1ml/L spraying at 50% & 100% pod maturity	0.88 (0.27)	0.71 (0.00)	0.71 (0.00)	2.04 (3.66)	1.08 (0.67)
10	Neemazal 10000 ppm @1ml/L spraying at 50% pod maturity	3.18 (9.61)	7.39 (54.11)	7.90 (61.91)	9.56 (90.89)	7.01 (48.64)
11	Neemazal 10000 ppm @1ml/L spraying at 100% pod maturity	2.67 (6.63)	7.60 (57.26)	7.84 (60.97)	8.16 (66.09)	6.57 (43.99)
12	Neemazal 10000 ppm @1ml/L spraying at 50% & 100% pod maturity	1.74 (2.53)	15.79 (248.82)	6.97 (48.08)	4.22 (17.31)	7.18 (51.05)
13	Control	6.62 (43.32)	20.32 (412.40)	19.70 (387.59)	13.24 (174.80)	14.97 (223.60)
	S.Em. +/-	0.25	0.72	0.35	0.24	1.67
	CD at 5%	0.72	2.10	1.02	0.71	4.79
	C.V.%	10.74	15.64	10.20	6.77	12.51
	Y					
	S.Em. +/-		--	--	--	0.93
	CD at 5%		--	--	--	2.66
	Y X T					
	S.Em. +/-		--	--	--	0.44
	CD at 5%		--	--	--	1.23

Conclusion

From the above study, it was observed that pulse beetle infestation can be prevented in stored green gram seeds by giving pre harvest sprays in the field. Among the different treatments, spraying of Profenophos 50 EC @ 10 ml/10 litre of water or Emamectin benzoate 5SG**,** 3.0g/10 litre of water at

50 & 100% pod maturity stage of green gram stage were found more effective than single spray either at 50% pod maturity or at 100% pod maturity.

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