The Pharma Innovation Journal 2023; 12(1): 2768-2770

www.ThePharmaJournal.com

The Pharma Innovation

**ISSN (E): 2277-7695**
**ISSN (P): 2349-8242**
**NAAS Rating: 5.23**
TPI 2023; 12(1): 2768-2770

www.thepharmajournal.com
Received: 15-10-2022
Accepted: 18-11-2022

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# Management of pulse beetle (*Callosobruchus chinensis* L.) in chickpea using biorational products

**Pratik Rajendra Phadtare, CS Chaudhari, ST Aghav, UK Kadam, TR Chavan and MR Patil**

**Abstract**
The research was conducted to study the efficiency of various biorational products against pulse beetle in chickpea during year 2021-22 at Post Graduate Institute, MPKV, Rahuri. The result shows that neem oil + APSA 80 was most effective in controlling seed damage and weight loss caused by pulse beetle up to 270 days of storage followed by neem oil sole. In respect of seed treatments with powders, the treatment of diatomaceous earth @ 5 g/kg seeds were found most promising. The seeds treated with neem oil + APSA 80 (85.00%) maintained seed germination percent above IMSC standard level up to 9 months storage followed by seed treatment with neem oil (84.50%). The adjuvant APSA 80 found to be effectives in enhancing the effectiveness of oils and chemical. The chemical check deltamethrin + APSA 80 and deltamethrin was most superior to all treatments in all parameters used during research.

**Keywords:** Chickpea, pulse beetle, biorationals, APSA 80

## Introduction
Chickpea, (*Cicer arietinum* L.) is an important pulse crop belongs to family Fabaceae widely grown in India. Pulse beetle attack mainly in storage conditions but infestation may start from the field during the maturity of the crops and is carried into the storage, hence it act as hindrance to storage of chickpea. In legumes, more than 40-50 percent of grains were found to be damaged by pulse beetle (Sinha & Srivastava, 2005) [6]. The botanical offers the potential for developing safer pesticides which can be used in integrated pest management. As they are comparatively safer for human beings and rapidly biodegradable nature can be made alternatives for synthetic pesticides. Moreover, in house hold storage the use of chemicals is hazardous and people are reluctant to apply chemicals considering food quality. Hence present research work was undertaken to evaluate the efficiency of different biorational products *viz.* castor oil, neem oil, groundnut oil, wood ash, boric powder, eucalyptus leaf powder, Clay powder, diatomaceous earth, and oils with combination with APSA 80 adjuvants against pulse beetle

## Materials and Methodology
The experiment was laid out in CRD with 14 treatments and two replications at Pulse Improvement project, MPKV, Rahuri at ambient temperature for the duration of nine months. The various biorational products (Table 1) were used as a protectant on chickpea seeds of the variety Phule Vikram.
The initial culture of pulse beetle (*Callosobruchus chinensis*) was maintained on disinfected chickpea seeds at ambient conditions in plastic jars. F1 emerges out were used for experiment purpose and five pairs of adult insects were released in seeds treated with biorationals. The oils were applied by smearing on seeds while powders were mixed thoroughly applied by adding the required amount of powders in to seeds. In case of combination treatment of oils with adjuvant APSA 80, the oils were first mixed with APSA 80 and smeared on seed in a manner similar to oils. The chemical treatment of deltamethrin and deltamethrin + APSA 80 were applied by diluting required quantity in 5 ml of seeds and then applied to seeds. Then seeds treated with biorational products were dried under the shed on plastic paper and then used for the experiment. The observations were recorded at every three months of interval up to 270 days after storage. The observations on following parameters were recorded
The hundred seeds were drawn at time of observation and percent weight loss was calculated by using following formula. (Soe *et al.*, 2020) [7].

Percent weight loss = [(U x Nd) – (D x Nμ) / U (Nμ + Nd)] x 100

Where,
(U = weight of undamaged grains Nμ = number of undamaged grains D = weight of damaged grains Nd = number of damaged grains).

The percent infestation/damage to the seeds was calculated by the following formula. (Jatav *et al.*, 2022) [2] Percent infestation = (Number of holed seeds/Total Seed) x 100 A hundred seeds were drawn from each treatment in two replications. The seeds were placed on wetted germination paper using between paper method. The rolls of paper kept on trays were placed in a germinator set at 25 ± 2 °C and 90% relative humidity and gemination was calculated by using following formula. (Dawae, 2008) [1].

Percent germination = (Total number of germinated seeds/Total number of seeds in sample) x 100.

**Result and Discussion**

Table 1 displays the analyzed data on the percentage of seed germination at 0, 90, 180, and 270 days after seed treatment. In treatments with biorationals seeds treated with neem oil + APSA 80 recorded highest seed germination at 270 days after storage (85.00%) which was above the IMSC standards and lowest was recorded by seeds treated with wood ash (74.00%). In all treatments seed treated with insecticidal check deltamethrin 2.8 EC (86.00%) and deltamethrin 2.8 EC (85.00%) recorded highest germination and lowest was observed in untreated control (68.00%). Any biorational treatments does not affect germination of chickpea seeds adversely. Neem oil + APSA 80 was found to be superior among all biorational treatments followed by treatment with neem oil alone the current results of neem oil are in line with the findings of Nishad *et al.* (2020) [3] and Ramya *et al.* (2017) [4].

At 90 days after storage, the seeds treated with deltamethrin + APSA 80, neem oil + APSA 80, and deltamethrin were found free from infestation. After 270 days of treatment, the seeds treated with neem oil + APSA 80 were effective in checking the infestation of seeds to the minimum level of damage with compare to all other biorational treatments followed by neem oil sole. The wood ash was found to be least effective among biorational products. The enhancement in efficacy is certainly due to surfactant action of APSA 80 which facilitates the uniform coating neem on the seed surface. However, there is no such literature on use of APSA 80 in earlier research on storage pest to support the current finding. But present findings are in analogous with findings by Sharma *et al.* (2022) [5] and Nishad *et al.* (2020) [3] where they were reported neem oil as a was superior protectants against pulse beetle up to nine months. Similarly, Ramya *et al.* (2017) [4] against pulse beetle and they also found that neem oil gave the best protection against the damage amongst tested oils. The highest seed damage of chickpea seeds was seen in those seeds treated with wood ash which also in line with results of Sunitha *et al.* (2013) [8].

The observations were recorded on seed weight loss caused due to the damage of pulse beetle (*Callosobruchus chinensis* L.) at 90, 180, and 270 days after storages (Table 1). The results revealed that chickpea seeds treated with neem oil + APSA 80 were most effective in controlling seed weight loss caused by pulse beetle during storage of chickpea at room temperature which was followed by neem oil alone. These treatments were more effective than all oils and powders used during experiments except the chemical treatment deltamethrin + APSA 80 and deltamethrin which were found most prominent among all treatments. The highest weight loss was observed in the untreated control. Among biorational products the highest amount of weight loss was seen in seeds treated with wood ash. However, all treatments were effective in checking weight loss caused by pulse beetle in chickpea up to 270 days of storage as compare to untreated seeds. It indicates that addition of adjuvant APSA 80 enhances effectiveness of neem oil and deltamethrin as it acts as surfactant which improves it's smearing over seed surface. There was no specific work carried out earlier on the addition of addition of adjuvant APSA 80 the research work on storage pests. Neem oil alone when smeared on seeds found to best protectant among the remaining biorationals and the similar results were registered by Ramya *et al.* (2017) [4] who evaluated different oils against pulse beetle and neem oil was found to be the best in protecting the seeds of green gram. Nishad *et al.* (2020) [3] and Sharma *et al.* (2022) [5] carried out research on evaluation of biorational for the management of pulse beetle and found the similar result that neem oil was effective than all treatments. However, highest weight loss was observed in wood ash which was anonymous with the findings of Sunitha *et al.* (2013) [8].

**Table 1:** Effect of different biorational products on germination, seed infestation and weight loss of chickpea seeds

| Tr. No. | Treatments | Dose (per kg of seeds) | Germination (%) | | | | Infested seed (%) | | | Weight loss (%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0 DAS | 90 DAS | 180 DAS | 270 DAS | 90 DAS | 180 DAS | 270 DAS | 90 DAS | 180 DAS | 270 DAS |
| 1 | Castor oil | 5 ml | 97.50 (80.91)* | 90.00 (71.55) | 85.00 (67.19) | 79.00 (62.70) | 3.00 (9.97)* | 11.50 (19.81) | 17.50 (24.71) | 2.15 (8.41)* | 8.06 (16.48) | 14.17 (22.10) |
| 2 | Neem oil | 5 ml | 96.00 (78.52) | 93.00 (74.66) | 88.50 (70.16) | 84.50 (66.79) | 1.50 (6.93) | 4.00 (11.53) | 9.00 (17.45) | 0.40 (3.61) | 2.31 (8.73) | 8.15 (16.58) |
| 3 | Groundnut oil | 5 ml | 96.00 (78.52) | 89.00 (70.62) | 82.00 (64.87) | 75.00 (59.98) | 5.00 (12.91) | 13.50 (21.54) | 22.00 (27.96) | 3.24 (10.36) | 11.65 (19.95) | 18.32 (25.33) |
| 4 | Wood ash | 20 g | 97.50 (80.91) | 88.00 (69.72) | 80.00 (63.43) | 73.00 (58.69) | 10.00 (18.42) | 18.50 (25.47) | 25.50 (30.31) | 5.13 (13.08) | 15.36 (23.06) | 22.29 (28.16) |
| 5 | Boric powder | 5 g | 98.00 (82.11) | 90.50 (72.02) | 86.50 (68.44) | 81.00 (64.14) | 4.00 (11.53) | 8.00 (16.42) | 12.50 (20.69) | 2.89 (9.78) | 5.97 (14.13) | 11.68 (19.98) |
| 6 | Eucalyptus leaf powder | 10 g | 97.50 (80.91) | 88.50 (70.16) | 80.50 (63.79) | 74.00 (59.60) | 7.00 (15.36) | 15.50 (23.17) | 23.50 (28.98) | 4.73 (12.53) | 13.70 (21.71) | 21.49 (27.60) |
| 7 | clay powder | 2.5 g | 97.00 | 88.00 | 81.00 | 74.50 | 6.00 | 13.50 | 20.50 | 4.13 | 10.76 | 17.39 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (80.13) | (69.70) | (64.15) | (59.67) | (14.17) | (21.54) | (26.90) | (11.72) | (19.14) | (24.63) |
| 8 | Diatomaceous earth | 5 g | 97.00 (79.99) | 90.50 (72.04) | 87.50 (69.27) | 83.00 (65.63) | 2.00 (8.12) | 7.00 (15.33) | 11.50 (19.81) | 1.71 (7.51) | 4.04 (11.59) | 10.90 (19.26) |
| 9 | Deltamethrin 2.8EC | 0.04 ml | 96.00 (78.52) | 94.00 (75.83) | 89.00 (70.62) | 85.00 (67.19) | 0.00 (0.00) | 2.00 (8.12) | 4.50 (12.22) | 0.00 (0.00) | 0.79 (5.10) | 3.43 (10.66) |
| 10 | Castor oil + APSA 80 | 5 ml + 1 ml | 96.00 (78.52) | 92.00 (73.57) | 88.00 (69.72) | 84.00 (66.40) | 2.00 (8.12) | 6.00 (14.17) | 11.00 (19.34) | 0.83 (5.22) | 3.34 (10.52) | 10.23 (18.65) |
| 11 | Neem oil + APSA 80 | 5 ml + 1 ml | 96.00 (78.52) | 94.00 (75.83) | 89.50 (71.06) | 85.00 (67.59) | 0.00 (0.00) | 3.00 (9.97) | 5.00 (12.91) | 0.00 (0.00) | 1.34 (6.59) | 4.84 (12.69) |
| 12 | Groundnut oil + APSA 80 | 5 ml + 1 ml | 97.00 (79.99) | 91.50 (73.04) | 86.00 (68.01) | 82.00 (64.87) | 2.00 (8.12) | 10.50 (18.89) | 15.50 (23.17) | 1.32 (6.05) | 6.25 (14.47) | 13.20 (21.29) |
| 13 | Deltamethrin 2.8 EC + APSA 80 | 0.04 ml + 1 ml | 96.00 (78.52) | 94.50 (76.46) | 91.50 (73.02) | 86.00 (68.01) | 0.00 (0.00) | 1.00 (5.73) | 3.00 (9.97) | 0.00 (0.00) | 0.29 (3.06) | 2.04 (8.20) |
| 14 | Untreated Control | | 97.00 (79.99) | 87.00 (68.85) | 76.00 (61.31) | 68.00 (56.15) | 15.00 (22.77) | 24.50 (29.65) | 33.50 (35.35) | 9.20 (17.65) | 18.13 (25.19) | 30.53 (33.54) |
| | SE(m) ± | | 1.17 | 0.97 | 0.67 | 0.63 | 0.31 | 0.29 | 0.41 | 0.11 | 0.27 | 0.30 |
| | CD at 5% | | NS | 2.97 | 2.07 | 1.94 | 0.97 | 0.89 | 1.28 | 0.34 | 0.84 | 0.93 |

*Figures in parentheses are arc-sine transformed values
DAS= Days after storage

## Conclusion

Among the all biorationals the seeds treated with neem oil @ 5ml/kg + APSA 80 @ 1 ml/kg was found to be most effective in protecting the chickpea against pulse beetle (*Callosobruchus chinensis* L.) and also shown germination above IMSC standards after nine months with minimum loss in weight of the seed. Neem oil @ 5 ml/kg chickpea seeds found to be the best sole treatment in terms of percent damage and inhibit the loss in weight of seeds but, maintained germination above IMSC standards up to 6 months only. The adjuvant APSA 80 was effective in enhancing the efficacy of oils and chemicals when applied in combination @ 1ml/ kg seeds against the pulse beetle but it was not cost effective.

## Acknowledgment

The authors are highly thankful to department of Agricultural Entomology, MPKV, Rahuri for providing necessary facilities and no conflict of interests.

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