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Effect of solarization against bruchid infestation and seed germination in cowpea (*Vigna unguiculata* (L.) Walp.) cv. IT38956-1 during storage

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Abstract
A laboratory study was conducted to know the effect of solarization against bruchid infestation and seed germination in cowpea (*Vigna unguiculata* (L.) Walp.) during July 2018 to April 2019 in the Department of Seed Science and Technology and National Seed Project, University of Agricultural Sciences, GKVK, Bengaluru. The statistical design used for study was completely randomized block design (CRD). The study consists of eight treatments with three replications. The experiment results revealed that solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 6 days recorded significantly least insect infestation (3.5%), number of dead insects (5.75%), number of live insects (4.25%) and highest germination (70.67 %) compared to control after nine months of storage under ambient condition.

Keywords: Bruchid, cowpea, germination, polyethylene, solarization

Introduction
Cowpea [*Vigna unguiculata* (L.) Walp.] is an important source of human dietary protein and calories cultivated for seed, fodder, green pods, green manure and cover crop. It is one of the most widely adapted, versatile and nutritious grain legume. It is a good source of protein (22-27%), carbohydrate, fat, vitamins and phosphorus.

Worldwide cowpea is cultivated in an area of 14.50 million hectares with a production of 6.50 million tons, of which more than 70 per cent contribution is from Nigeria (Fatokun *et al*., 2014) [9]. In India, it is cultivated in an area of 3.1 m. ha. with a production of 1.92 m.t. (Anon., 2016) [3]. Karnataka accounts for 12 per cent of area under pulses in the country and among all pulses in Karnataka, cowpea stands fourth position with an area of 0.81-lakh hectare with a production of 0.32 lakh tones (Anon., 2016b) [4]. In Karnataka, productivity of cowpea is as low as 3.68 q/ha as compared to national productivity of 5.7 q/ha. In India, major cowpea growing states are Rajasthan, Gujarat, Karnataka, Tamil Nadu, Kerala and Andhra Pradesh (Anand *et al*., 2016) [2].

Infestation of the cowpea pods by the bruchids (*Callosobruchus maculatus)* starts in the field and continues in storage. Bruchid is minor pests in the field, which assume a major pest during seed storage. It is a cosmopolitan field-to-store pest of cowpea, which causes substantial quantitative and qualitative losses manifested by seed perforation and reduction in weight, market value and germinability of seeds. Being a major pest of cowpea, black gram and other grain legumes, the spotted cowpea weevil, *Callosobruchus maculatus* (F) is an important pest of pulses in Africa and tropical Asia both in field crops and in stored seeds. The pest causes damage only at immature stages, because the adults normally do not feed in the granaries. Under traditional storage conditions, 100 per cent infestation of cowpea seeds damaged by the bruchids within 3 to 5 months of storage (Adebayo and Anjorin, 2018) [1].

Solar heating of cowpea is one of the alternatives, less hazardous and safe method to control *C. maculatus*. Eggs deposited on the surface of the seeds exposed to high temperature and low humidity will desiccate as a result deformed. Therefore, bruchids living within seed are excellent targets for management using elevated temperature. Farmers in many parts of the tropics are already using solar heat as a means of driving out insects from infested seeds and, perhaps, in an attempt to kill any larvae which may be inside the seeds. The effectiveness of the technique depends upon spreading the seeds in thin layer and exposing them to the sun for a long period.

Solar disinfestations technology is an effective, low cost, non-toxic pest control process, which does not alter the physical, cooking, nutritive, and other desirable properties of the cowpea grain (Adebayo and Anjorin, 2018) [1].

Material and Methods

A laboratory experiment was conducted to know the effect of solarization against bruchid infestation in cowpea (*Vigna unguiculata* (L.) Walp.). Freshly harvested cowpea seeds of cv. IT38956-1 was procured from Seed Processing Unit, National Seed Project, GKVK, Bengaluru. It was cleaned, dried were insect damage and live insects are nil and well.

Cowpea seeds were inoculated with five pairs of pulse bruchids per kg for fifteen days. One kilogram of seed was packed in 700-gauge polythene packets and solarization was taken up as per recommendations.

There were eight treatments replicated thrice in completely randomized block design (CRD). Treatments are

- **T_1:** Solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 2 days
- **T_2:** Solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 4 days
- **T_3:** Solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 6 days
- **T_4:** Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3h for 2 days
- **T_5:** Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3h for 4 days
- **T_6:** Solarization of inoculated-seeds in clear polyethylene (700 gauge) packet for 3h for 6 days
- **T_7:** Control (fresh seed)
- **T_8:** Control (inoculated seed)

Plate 1: Fresh cowpea seeds

Plate 2: Inoculated cowpea seeds with bruchids

Observations of all the parameters were recorded bimonthly up to six months and monthly after six months up to nine months of cowpea seed storage (July, 2018 to April, 2019). All the observations were taken by sampling of four hundred seeds from each 700-gauge polyethylene packet. Whereas, percent seed infestation was recorded as per the method prescribed by International Seed Testing Association (ISTA, 2010) [10] by randomly drawing four hundred seeds from each treatment and replication, number of damaged seeds were counted and expressed as per cent damage by using following formula.

$$\text{Per cent seed damage} = \frac{\text{Number of seeds damage}}{\text{Total number of seeds}} \times 100$$

The germination test was conducted by adopting between paper methods as prescribed by ISTA (2010) [10].

Results and Discussion

The results of the present study as well as relevant discussion have been summarized under following heads:

Seed infestation (%)

During nine months after storage, all the treatments were significantly differing and increase in the seed infestation were observed. The seed infestation results were varied from 0 to 19.33 per cent by the end of the storage period (Table 1) (Fig. 1). The maximum seed infestation (19.33 %) was found in control (inoculated seed; T8) after nine months of storage. Gradual increase in the seed infestation was observed in storage ecosystem of cowpea seeds from two months to nine months during storage. It showed the gradual increase in the seed deterioration and adult insect population in control than other treatments. Minimum seed infestation (3.50 %) was found in solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 6 days (T3) after nine months of storage. Sun exposure of bruchid-infested seeds to 40 to 50◦ C reduces the seed infestation (Lale and Vidal, 2003) [11]. Moumouni *et al.* (2014) [14] reported that when seeds are kept under sun radiations it significantly inhibits the development of *Callosobruchus Maculatus***.** These results were confirmative with Deshpande *et al.* (2011) [7] and Manisha *et al.* (2017) [13].

Table 1: Effect of solarization against Seed infestation, number of live insects, dead insects and seed germination in cowpea (*Vigna unguiculata* (L.) Walp.) cv. IT-38956-1 seeds at nine months after storage.

Treatments	Seed infestation (%)	Live insects (%)	Dead insects (%)	Seed germination (%)
T_1	5.75 (13.87)	4.75 (12.59)	6.25 (14.48)	69.33
T_2	5.42 (13.46)	4.42 (12.13)	5.92 (14.08)	68.67
T_3	3.50 (10.78)	4.25 (11.90)	5.75 (13.87)	70.67
T_4	6.50 (14.77)	5.50 (13.56)	7.00 (15.34)	65.33
T_5	6.25 (14.48)	5.25 (13.25)	6.75 (15.06)	66.33
T_6	5.67 (13.77)	4.67 (12.48)	6.17 (14.38)	66.67
T_7	18.75 (25.66)	16.79 (24.16)	19.25 (26.02)	60.67
T_8	19.33 (26.08)	17.83 (24.98)	19.83 (26.45)	52.33

Mean	8.90	7.93	9.62	65.00
S.Em ±	0.31	5.03	0.30	0.97
CD at 5%	0.93	2.30	0.90	2.91
CV (%)	3.24	3.22	3.00	2.59

Live insects (%)

The number of adult live Insects results were varied from 0 to 17.83 per cent. The maximum number of adult live insects (17.83 %) were found in control (inoculated seed; T8) after nine months of seed storage. Gradual increase in the number of adult live insects was observed in cowpea seeds from two months to nine months during storage. There is a gradual increase in the insect population and seed deterioration under ambient condition in control than other treatments. Minimum number of adult live insects (4.25 %) was found in solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 6 days (T3) after nine months of storage. Solar heating of seeds was effective in eliminating eggs of bruchids and then protecting seeds from bruchid damage in pigeon pea seeds (Chauhan and Ghaffar, 2002) [5]. Sun exposure of bruchid infested seeds at 40 to 500 C, which reduces the developmental stages of bruchids (Lale and Vidal, 2003) [11]. No emergence of progenies in neem seed oil treated seeds with 4 hours exposure to sun radiations (Maina and Lale, 2004) [12] in cowpea seeds. Exposure of cowpea seeds to 500 C for 2 hours leads to complete disinfection of bruchids (Dattijo *et al*., 2009) [6]. Sonali *et al*. (2018) [15] also reported that the developmental stage at 420 C get seized in bruchids. These recorded results were in accordance with Manisha *et al***.** (2017) [13].

Plate 3: Damaged cowpea seeds of T_3 at nine months after storage

Plate 4: Damaged cowpea seeds of T_8 at nine months after storage

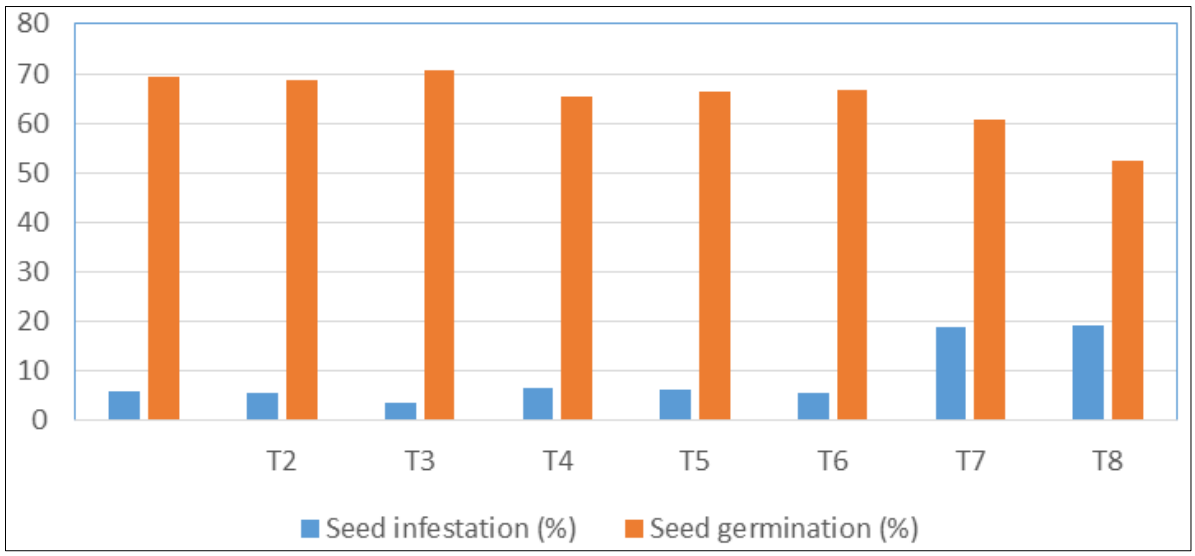

Fig 1: Influence of solarization on seed infestation (%) and germination (%) of cowpea

Dead insects (%)

The number of dead insects results were varied from 0 to 19.83 per cent. The maximum number of dead insects (19.83 %) was found in control (inoculated seed; T8) after nine months after storage. Gradual increase in the number of dead insects was observed in cowpea seeds from two months to nine months during storage. It showed the gradual increase in the insect population due to lower development period of

bruchids under ambient condition. Minimum number of dead insects (5.75 %) was found in solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 6 days (T3) after nine months of storage. It may be attributed to the fact that when the seeds are kept under sun exposure it significantly inhibits egg laying, embryonic development and postembryonic development of *C. maculatus* resulting in complete inhibition of the emergence of the offspring in cowpea seeds (Moumouni *et al*., 2014) [14].

Seed germination (%)

The germination results varied from 88 per cent to 52.33 per cent. The maximum germination (70.67 %) was found in solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 6 days (T3) and the minimum germination (52.33 %) was found in control (inoculated seed; T8) after nine months of storage. This shows natural ageing of cowpea seeds and level of bruchid infestation. There is drastic decrease in seed germination after seven months of treatment imposition, which is due to insect infestation decreases the seed germinability by making holes and consumption of seed reserve. These holes are responsible for the entering of harmful microorganisms and interfere with the water intake, which retards the seed germination (Sonali *et al*., 2018) [15]. The results of this study were in line with the findings of Divya *et al*. (2018) [8] in horse gram seeds, Manisha *et al*. (2017) [13] and Deshpande *et al*. (2011) [7] in cowpea.

Conclusion

Solarization is an eco-friendly technique to manage pests and maintain healthy seeds through effective utilization of solar energy. Extensive research in the past has shown that solarization is an effective method of controlling insect infestation. From the present study, it is be concluded that the treatment with Solarization of fresh seeds in clear polyethylene (700 gauge) packet for 3h for 6 days (T_3) recorded significantly least insect infestation (3.5%), number of dead insects (5.75%), number of live insects (4.25%) and highest germination (70.67 %) compared to control after nine months of storage.

References

1. Adebayo RA, Anjorin OO. Assessment of entomocidal effects of solar radiation for the management of cowpea seed beetle, *Callosobruchus maculatus (f.)* (Coleoptera: Chrysomelidae) in stored cowpea. Global J Sci. Frontier. Res.: Agri. Vet., 2018;18(2):21-26.
2. Anand S, Singh YV, Asheesh S, Amit V, Mithilesh KS. Surendra S. Genetic analysis of quantitative traits in cowpea [*Vigna unguiculata* (L.) Walp.] using six parameters genetic model. Legume Res., 2016;39(4):502-509.
3. Anonymous. Agriculture production year book. Food and Agriculture Organization of United Nations, Rome, 2016.
4. Anonymous. State agriculture profile, 2016b. http://www.raitamitra.kar.nic.in.
5. Chauhan YS, Ghaffar MA. Solar heating of seeds- a low cost method to control bruchid (*Callosobruchus* spp.) attack during storage of pigeonpea. J Stored Product Res., 2002;38:87-91.
6. Dattijo Shehu, Abduljalal, Dawakiji Ado, Yusuf. Different modified atmospheres in the control of cowpea weevil (*Callosobruchus maculatus* (fab.)) And Bambara groundnut weevil (*Callosobruchus subinnotatus* (pic)) on two stored legumes. Techno. Sci. Africana. J. 2009;5:5-9.
7. Deshpande VK, Basavaraj Makanur, Deshpande SK, Sateesh Adiger, Salimath PM. Quantitative and qualitative losses caused by *Callosobruchus maculates* in cowpea during seed Storage. *Plant. Arch*., 2011;11(2):723-731.
8. Divya P, Kanaka Durga K., Rajasri M, Sunil N, Keshavulu K, Udayababu P. Effect of *Callosobruchus chinensis* on seed quality parameters of horse gram accessions during storage. *Legume. Res*., 2018;(41)1:143-149.
9. Fatokun CA, Boukar O, Muranaka S. Evaluation of cowpea (*Vigna unguiculata* (L.) Walp.) germplasm lines for tolerance to drought. Plant Genetic Resources, 2014;10:171-176.
10. ISTA. International rules for seed testing, Zurich, Switzerland, 2010.
11. Lale NES, Vidal S. Simulation studies on the effects of solar heat on egg-laying, development and survival of *Callosobruchus maculatus* (F.) and *Callosobruchus subinnotatus* (Pic) in stored Bambara groundnut *Vigna subterranean* (L.) Verdcourt. J. Stored. Products. Res. 2003;39:447-458.
12. Maina YT, Lale NES. Integrated management of *Callosobruchus maculatus* (F.) infesting cowpea seeds in storage using varietal resistance, application of neem (*Azadirachta indica* A. Jussf) seed oil and solar heat. *Intl. J. Agri. Bio*., 2004;6(3):440-446.
13. Manisha Sharma, Agrawal VK, Suman Choudhary. Effect of solar treatment and different colours on *Callosobruchus chinensis* on cowpea under storage condition. Intl. J Dev. Res. 2017;7(7):14117-14119.
14. Moumouni DA, Doumma A, Seyni IS. Effect of solar drying on the biological parameters of the cowpea weevil, *Callosobruchus maculatus* fab. (Coleoptera-Bruchidae), in sahelian area. J App. Biosci. 2014;84:7723-7729.
15. Sonali Verma, Monika Malik, Parveen Kumar, Darshna Choudhary, Jaiwal PK, Ranjana Jaiwal. Susceptibility of four Indian grain legumes to three species of stored pest, bruchid (*Callosobruchus*) and effect of temperature on bruchids. Intl. J Ent. Res. 2018;(3)2:05-10.