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Impact of hot pepper, black pepper, Ginger and Moringa powder extracts against cowpea weevil *Callosobruchus maculates* and two storage methods on cowpea, Mogadishu, Somalia

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Abstract
Cowpea weevil (*Callosobruchus maculates*) is a serious Cowpea pest which affects and destroys severely the grain within short period of 6 month in an open field and during storage period. This study aimed to evaluate the performance of hot pepper, black pepper, ginger and Moringa powder extracts and two storage methods against cowpea weevil. Laboratory experiment was conducted at plant protection laboratory of the faculty of Agriculture and Environmental Science-Somali National University during 15 June - 25 December, 2019. The design of experiment was laid out in completely randomized design (CRD) with five treatments and three replications. Hot pepper, black pepper, Moringa and ginger powders extracts at the same concentration of (4 gram) were applied on 20 insects in 100 gram of local cowpea variety as primary host for cowpea weevil. Meanwhile, two comparative storage methods of traditional and modern methods have been used to store 10 kg of cowpea in each method. The results indicated that all powder treatments were effective against cowpea weevil compared to the untreated control. Significant different at $p<0.05$ in the mean number of insect pests were found. The study showed that 4gram of each hot pepper and black pepper was the most effective one among the selected natural products in reducing the number of weevils at mortality number of (%100) insects/jar compared to the other concentration as well as control treatment. A significant difference of weight losses was observed between treatments, where the 4gram of hot pepper and black pepper were recorded the lowest level of weight loss at the mean numbers of (4.3, 5) insects/jar respectively comparing to the other treatments. On the other hand, hermetic storage was the most effective in reducing the pest infestation and weight loss of cowpea. This study recommended that applying; 4gram of each hot pepper and black pepper and using a hermetic storage reduce the number of cowpea weevil in cowpea grain.

Keywords: *Callosobruchus maculatus*, *Vigna unguiculata*, mortality, weight loss

Introduction
Cowpea (*Vigna unguiculata* L. Walp) is an important food legume and an essential component of sustainable cropping systems in the sub humid tropics and generally dry regions across the globe (Singh *et al.*, 2002) [26]. Cowpea belongs to the family Fabaceae (Leguminosae) genus Vigna, and species *Unguiculata*, (Verdcourt, 1970; Maréchal *et al.*, 1978) [27-28]. The cowpea is one of the strongest lines of evidence favoring Africa as the origin of the crop widespread distribution of the wild cowpea within Africa, some favored Ethiopia as the region of origin (Vavi1ov~ 1951), Steel (1972) [33]. In wildlife, Cowpea is eaten by deer as forage, and is commonly used in food plots for deer. A variety of birds, including wild turkey, eat the seeds and the plant can be used by quail as cover. (Ball *et al.*, 2007) [34].

In some African countries, several varieties of Cowpea has been grown together for both food and feed, Cover crop and green manure (Cook *et al*., 2005) [29]. Cowpea have its long taproot and wide, vegetative spread make it an excellent plant for erosion prevention and weed suppression (Clark, 2007) [5]. Despite, the cowpea has its economic importance still, it is suffering from different diseases and pests: The major diseases are: bacterial blight, bacterial pustule, Ascochyta blight, Cercophora leaf spot, brown and false rusts, web blight, Pythium stem rot, ashy stem blight and Phytophphtora stem rot (Emechebe and Shoyinka, 1985) [30].

The major insect pests which causes crop losses in cowpea are: Aphids, flower thrips, legume pod borers, complex of pod sucking bugs e and cowpea weevil. (Raheja, 1976) [31].

Cowpea weevil (*Callosobruchus maculatus*) is a serious Cowpea pest which affects in open field and during the storage period severely. It can completely destroy the grain within 6 months, although it's considered medically harmless to humans. (*Callosobruchus maculatus*) cause major losses-estimated at US$ 30 million annually in Nigeria alone (Ogbuinya, 1997) [32]. Cowpea weevil infestation can be managed using most effective cultural methods such as intercropping, sanitation, solarisation, resistance varieties and Hermetic storage (process of removing oxygen present in the atmosphere) (Murdock, Baoua, I.B. 2014) [18]. Biological control also can be use for cowpea management such as predators of *C. maculatus* as well as several parasitoid wasp i.e, *Uscana mukerjii* and Dinarmus specifically targeted Callosobruchus species. The Effective insecticides such as, organochlorines, organophosphorus, Quick phos and dichlorvos can be used to regulate cowpea weevil. (Shade, R.H. 2012) [35].

Despite, the using of synthetic chemicals for cowpea weevil management can leave undesirable residues and contamination on food, developing of resistance from the pest and environment toxicity and since the alternative pesticides are environmentally friend with low cost, ecologically safer and less residues than synthetic insecticide. The broad objective of this study was to evaluate the performance of hot pepper, black pepper, ginger and moringa powder extracts and two storage methods against cowpea weevil. To reach this objective, four other objectives had been specified. To manage cowpea weevil using effective alternative pesticides. To assess the most effective one among hot pepper, black pepper, ginger and moringa. To evaluate weight losses, cause by cowpea weevil on grain cowpea. To investigate two different storage techniques of traditional and hermetic storage and recognize the optimum method for reduction of cowpea weevil infestations.

Materials and Methods

The experiment was conducted at the plant protection laboratory of the faculty of agriculture and environmental science. Somali National University, during 15 June to 25 December 2019. The species of cowpea weevil, *Callosobruchus maculates* were collected from infested cowpea in Bakaro market, the insect was identified in the plant protection laboratory of the faculty of agriculture and environmental science in SNU at Polytechnique campus. The collected adult weevil, were transferred to plastic jars (21x15cm in diameter) for a number of generations before being used in the experiment and then supplied with cowpea seeds, *Vigna unguiculata* as rearing food. Rearing continued till adult numbers increased and some larval stages have been observed during the rearing period, thus all adults needed for experiments were available at any time. The plant materials of Hot pepper, black pepper, ginger and moringa were collected from Bakaro market and were grinded by machines (BOMINO) and then were sieved to separate the clean powder and rubbish.

The cowpea seeds were bought from local markets in Mogadishu capital and the seeds were checked by visual observation to ensure that they are free from infestation as well as the presence of eggs or any suspicious material. Hundred grams of un-infested cowpea seeds were put in plastic jars with 20 adults of cowpea weevil. Same grams of plant powder extracts i.e. Hot pepper, Black pepper, Moringa and Ginger were treated each number of cowpea pest in each plastic jars after infestation appeared, then, observation was started after 24 hours. Two storage methods were selected to store 10 kg of un- infested cowpea grains grains during 20/7/ till 25/12/2019. 10kg of completely dried cowpea free from an infestation were poured into the traditional bag storage without polyethylene sack, the sacks were sealed well**.** PICS bags (Purdue Improved Cowpea Storage) with two inner polyethylene sacks were also selected for appropriate and modern storage for cowpea at the same kilograms (10 kgs) with same quality of traditional seeds. The sack woven well and ensured that no any air container within the bag and twisted closed of each inner polyethene sacks to restricts the movement of insect and their gas exchanges internally and externally.

Fig 1: Traditional storage at the beginning

Fig 2: Hermetic storage at the beginning

The experiment was laid out in completely randomized design (CRD) with five treatments and three replications. Insects under the study were scouted weekly for any death during weekly routine to calculate the adult mortality rate. The dead ones were counted and discard, while the live ones were returned into plastic jar. The mortality rate for the cowpea weevil was calculated using the below equation: % Mortality =Number of dead insects/Total number of insects X 100%. The initial weight was taken, before introducing the adult cowpea weevils. Then the final weight of all treatments was measure at the last month of the experiment to record the differential weight loss between them. The weight loss was calculated by the equation below: % Weight loss =Initial weight –Final weight/Initial weight X 100%. The differential weight loss of both traditional and hermetic storage system was measured at the end of the experiment. The Data was analyzed using statistic 8 programs. Then Duncan multiplied range test (DMRT) was calculated for treatment means comparison.

Results

The effect of Hot pepper, Black pepper, Moringa and Ginger powders against adult Cowpea weevil (*Callosobruchus maculatus*). The overall results of this experiment contributed significantly the best performance of botanical treatments that is to say; 4 gram of each, Hot pepper, Black pepper, Moringa

and Ginger powders explored biological activity against cowpea weevil *Callosobruchus maculatus*. Data presented in table (1) displayed variable performance of hot pepper, Black pepper, Moringa and Ginger treatments at the same concentrations as to the pest incidence.

At the first week, the date clearly shown that treatments; 4 gram of each black paper and hot paper powders gave significantly (p<0.0 5) highest mortality of cowpea weevil at the mean numbers of (48.3, 45) insects respectively and no significant difference between them, related by the treatments of 4 gram moringa and 4 gram ginger at the mean number of (30, 28.33) insects respectively and no significant different among them. The treatment of untreated control had recorded the lowest mortality of cowpea weevil at mean number of (5) insects, and there is significant difference (p<0.0 5) between all treatments and control.

While the data exhibited in the second week indicated that the treatments of black paper and Hot paper recorded the highest significant number (p<0.0 5) of the morality of weevils at the mean number of (68.33, 65) insects respectively and no significant difference among them in the mortality of cowpea weevil, related by the treatments of moringa and ginger in the performance of weevils at mean number (51.6, 50) insects respectively. There is significant difference between all treatments and control.

In the third week, it was noticed that the treatments; 4gram of hot paper and black pepper has shown the highest performance of weevil's reduction in same mean number (90, 90) insects/jar respectively flowed by 4gram of Moringa and ginger treatments (80, 70) respectively. All treatments appeared significantly different than untreated control.

The data presented in week four declared that treatments; 4gram of hot paper and black paper registered the highest significant (p<0.0 5) mortality number (100, 98.33) insects/jar respectively, flowed by treatments 4gram of Moringa and ginger (90, 80) respectively. All treatments appeared significantly different than untreated control.

In the fifth week the data displayed that the treatments of 4gram of hot paper, black paper and moringa obtained the best performance for cowpea weevil reduction at the mean numbers (56.6, 54.6, 46.6) respectively, no significant($P < 0.0$ 5) difference between them, related by the ginger treatment at the mean number (26.6) insects/jar. The untreated control illustrated the lowest mean number for the mortality of weevil at the mean numbers(8.33).The treatments; hot paper, black paper and moringa registered significantly than untreated control and no significant different between the ginger and untreated control.

The data exhibited in week six revealed that the treatments; 4gram of hot paper, black paper and moringa were the highest treatments in the reduction of weevil population at the mean number (70, 65, 60) respectively and no significant (p<0.0 5) difference among them, related by ginger at the mean number (51.6) insect/jar. The untreated control was recorded zero mortality(0) that is to say all treatments in week six were excellent in mortality of cowpea compared to untreated control and highest one was the treatment of hot paper.

In week seven, the explored data revealed that all treatments; hot paper, black paper, moringa and ginger were gave best performance against cowpea weevil at the mean numbers (90, 81.6, 78.3, 70) respectively comparing to untreated control which gave zero mortality (0). There is significant (p<0.0 5) between the treatment hot paper and ginger (90, 70) respectively, but no significant different between other treatments in performance.

The data presented in week eight indicated that treatments; hot paper, black paper and moringa were gave best performance against cowpea weevil at the mean numbers (100,98.33,95,) respectively and no significant difference among hot paper, black paper, moringa and ginger in performance of cowpea weevil. The treatment ginger gave the lowest mean number (6.66) of mortality which showed no significant difference with untreated control which gave zero mortality (0).

In the week nine the treatments; hot paper, black paper and moringa were indicated the top treatments in performance of cowpea weevil without significant (p<0.0 5) difference among them at the mean numbers (68.33, 63.33, 41.66) respectively, comparing to untreated control which gave zero mortality (0). But the ginger treatment showed the poorest performance in pest reduction at the mean number (30) and no significant difference among ginger treatment and control.

The presented data in week ten enrolled that the treatments of hot paper, black paper and moringa were significantly (p<0.0 5) displayed the pest reduction at the mean numbers (88.33, 86.66,75) respectively, related by ginger treatment at the mean number (35) comparing to untreated control which gave zero mortality(0). No significant difference was observed within treatments, but there is significant difference among all treatments and control.

In week eleventh, the treatments of hot paper, black paper and moringa explored the highest performance in pest reduction at the mean numbers (98.33, 95, 91.66) respectively, related by ginger treatment at the mean number (35) comparing to untreated control that showed zero mortality (0). No significant difference was shown within treatments, but there is significant difference among all treatments and control.

The data presented in week twelve illustrated that, the treatments of hot paper, black paper and moringa explored the highest performance in pest reduction at the mean numbers(100,100, 98.33) respectively, related by ginger treatment at the mean numbers (83.33.) The untreated control was showed zero mortality (0). No significant difference was shown among treatments, but there is significant difference among all treatments and control.

The effect of Hot pepper, Black pepper, Moringa and Ginger powders on weight loss reduction of cowpea grain

Data presented in table (2) obviously presented that untreated control gave highest weight loss at the mean number of (59.33). The 4grm of each treatment of hot paper, black paper, and moringa recorded a lowest level of weight loss at the mean numbers (4.33,5,9) respectively, flowed by ginger treatment at the mean number of (38). All treatments were registered significantly (p<0.0 5) difference than untreated control.

Comparative study between traditional and hermetic storage methods: The findings of the storage methods presented in table (4) indicated that; Hermetic storage was able to stabilize the moisture content of stored cowpea compared to traditional storage. Furthermore, hermetic storage system drastically reduced the population dynamics of cowpea weevil inside the sack and slightly minimized weight loss and maintained its tenth kilograms till the end of trial, comparing to traditional storage which the infestation of cowpea weevil pest was increased and diminished from tenth kilogram to seventh kilogram.

Table 1: The mean Percentage of mortality of cowpea weevil treated by hot pepper, Black pepper, Moringa and Ginger in twelve weeks

Treatments	Weeks Of Treatment					
	Week 1 P:0.0002	**Week 2 P:0.0000**	**Week 3 P:0.0000**	**Week 4 P:0.0000**	**Week 5 P:0.0088**	**Week 6 P:0.0000**
H.P	45a	65ab	90a	100a	56.6a	70a
B.P	48.33a	68.33a	90a	98.33a	54.6a	65ab
Mr	30b	51.6bc	80ab	90b	46.6ab	60ab
Gr	28.33b	50c	70b	80c	26.6bc	51.6b
cont	5c	10d	5c	0d	8.33c	0c
S.E±	4.22	4.41	4.47	1.10	8.28	4.88
CV	23.31	15.59	11.56	4.64	37.16	17.16
	Week 7 P:0.0000	**Week 8 P:0.0000**	**Week 9 P:0.0034**	**Week 10 P:0.0002**	**Week 11 P:0.0000**	**Week 12 P:0.0000**
H.P	90a	100a	68.33a	88.33a	98.33a	100a
B.P	81.6ab	98.33a	63.33a	86.66a	95a	100a
Mr	78.3ab	95a	41.66ab	75a	91.66a	98.33a
Gr	70b	6.66b	30bc	35b	35b	83.33b
cont	0c	0c	0c	0c	0c	0c
S.E±	4.22	3.33	9.66	9.18	3.57	2.11
CV	11.41	9.62	41.15	27.92	9.67	4.78

*H.P: Hot pepper *B.P: Black pepper *M.R: moringa *G.R: Ginger *Cont: control.

Table 2: The mean Percentage of weight loss of cowpea weevil treated by Hot pepper, Black pepper, Moringa and Ginger in three months.

Treatment	Treatment means
	Weight loss after three months
4 gram of Hot paper	4.33c
4 gram of black paper	5c
4 gram of Moringa.	9c
4 gram of ginger	38b
Control	59.33a
S.E±	3.63
CV	27.18
P	0.0000

Table 3: The outcomes of stored cowpea in traditional and modern hermetic storages.

Storage cowpeas	Number of kilograms of cowpea pre storage	Number of kilograms of cowpea post storage
Traditional storage	10 kg	7 kg
Modern storage	10 kg	10 kg

Fig 3: The founded cowpea in traditional storage after six months

Fig 4: The founded cowpea in hemetic storage system after six mounts

Conclusion

Based on the results, this study concludes that: the powder extracts of hot paper black paper and moringa exhibited toxic action and significant efficiencies of repellent and anti-feeding against the cowpea weevils. The hot paper and black paper powder extracts at 4gram/100 insets gave best performance of mortality rates of cowpea weevil and lowest level of weight loss comparing to other treatments. Furthermore, the study also conclude that the hermetic storage was shown the appropriate one in performance of cowpea weevil regulation at storages and maintenance of stored kilograms in it, comparing to traditionally stored sack.

Recommendations

Hot pepper, black pepper, Moringa and ginger can be suggested for management of cowpea weevil in ware houses. Different concentrations of Hot and black pepper can serve as substitute for some synthetic insecticides. Maintenance of storing cowpeas in Hermetic storage system can mainly contribute the future safety of cowpea built. Further investigations for effective botanicals with low cost and highest performance for pest management are required.

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