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Efficacy of different botanical products on cowpea weevil (*Callosobruchus maculatus)* in stored cowpea seeds

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Abstract
An experiment was conducted to determine efficacy of different botanical product against storage pest of cowpea, Cowpea weevil (*Callosobruchus maculatus*), in completely randomized design (CRD) with seven treatments and three replications in entomology lab of Prithu Technical College, Lamahi, Dang. Effects of treatments on adult emergence of cowpea weevil, mortality of cowpea weevil and number of grains affected were assessed. Data were collected three times in every month interval taking 20 g sample randomly from each treatment. Mustard oil was very effective to the management of cowpea weevil as minimum mean adult emergence of cowpea weevil (25) and affected grains (23.33) and higher adult mortality of cowpea weevil (40) was recorded under the treatment of mustard oil at 90 days. This study clearly shows botanical products is very effective for the control of storage grain pest as well as maintaining higher quality of grains.

Keywords: Botanicals, *Callosobruchus maculates*, cowpea, management

Introduction
The cowpea seeds are an inexpensive source of very high vegetable protein [1]. On the average, cowpea seeds contain about 23 to 25% protein and are also a major source of other nutrients [2]. But different insect pest causes serious losses in crops both in the field as well as in the storage [3]. In storage condition, it is reported that insect completely damages the cowpea seeds [4]. Among the different storage insect, cowpea weevil (*Callosobruchus maculatus)* is the major pest of cowpea which causes serious losses in cowpea seeds by seed perforation and reduction in weight, market value and germination ability [5]. Cowpea weevil infestations can affect 100% of the stored seeds and cause up to 60% grain loss within a few months [6]. The problems associated to this pest are serious at small farmers' level, village traders and households. To control the pest Nepalese farmers are using both chemical and locally available different plant materials. In the context of increasing resistancy to chemical insecticides to storage insect, botanical pesticides may be the alternative to control them [7]. Hence, this is necessary to study the efficacy of different products against storage insect pest and this study was conducted to determine efficacy of different botanical products against storage pest of cowpea (*Callosobruchus maculatus*).

Materials and methodology
Experiment was conducted in entomology lab of Prithu Technical College, Lamahi, Dang, Nepal. The experiment was laid out in a completely randomized design (CRD) with 7 treatments and three replications.

Collection of botanical pesticides
Six botanical pesticides namely leaf of neem (*Azadiracta indica*), rhizome of ginger (*Zingiber officinale)*, leaf of Chinaberry tree (*Melia azedarach*), rhizome of sweet flag (*Acorus calamus*), mustard (*Brassica rapa*) oil and fruit of black pepper (*Piper nigrum*) were collected and let to them for shade dried for 48 hours. Then 18 bottles of grain were mixed with above mentioned different botanicals @ 5% (25gm/500gm) leaving three bottle as control.

Collection of cowpea and weevils

Cowpea seeds, variety Surya, were collected from Nepal Agriculture Research Council (Grain Legumes Research Program, Khajura, Banke) which content around 12% moisture level. 500 g cowpea grains were filled in plastic bottle. Adult cowpea weevils (*Callosobruchus maculatus*) were collected from farmers household. Male and female weevils were identified first and 20 weevils were released in each bottle kept in jars covered with muslin cloth held tightly with rubber band.

Observation and data collection

Observation and data collection was done in 30 days interval. During the period 20 g sample was randomly taken from each treatment and numbers of weevil (both live and dead) along with affected grains were recorded. Dead weevils were not placed after recording; however the affected grains were placed again.

Statistical analysis

All the data of experimental plots were analyzed by using R and R studio software. The data were subjected to analysis of variance (ANOVA) and significant mean differences were separated by Duncan's Multiple Range Test (DMRT) at 0.05 per cent level of significance [8].

Results

Mustard oil was found to be significantly superior throughout the experiment. Least adult emergence were found in mustard oil (25 adults) treatment after 90 days of treatment application followed by black pepper (36.67 adults), sweet (58.33 adults), whereas highest number was recorded in control (125 adults).

Table 1: Comparative efficacy of different botanicals on the adult emergence of cowpea weevil under different days of treatment in Dang, Nepal during 2018

S. No.	Treatments	30 days	60 days	90 days
1	Control	31.67^{a}	73.33^{a}	125^{a}
2	Ginger	13.33^{b}	43.33^{b}	86.67^{b}
3	Chinaberry	11.67^{bc}	40^{b}	70^{c}
4	Neem	8.33^{bcd}	33.33^{bc}	58.33^{cd}
5	Sweet flag	8.33^{bcd}	26.67^{cd}	45^{de}
6	Black pepper	6.67^{cd}	20^{de}	36.67^{ef}
7	Mustard oil	5^{d}	15^{e}	25^{f}
	Mean	12.14	35.95	63.81
	CV	31.13	17.70	12.21
	Lsd (0.05)	1.32	2.23	2.73

Highest grains were affected in control treatment as 145 number of grain, while least number of grains was affected in mustard oil treatment as only 23.33 grains after 90 days of treatment application as shown in Table 2. Along with mustard, black pepper was also effective as it has lesser number of affected grains and is ultimately showed results after as mustard oil.

Table 2: Number of grains affected by cowpea weevil under treatment of botanical pesticides in different days of treatment in Dang, Nepal, 2018.

S. No.	Treatments	30 days	60 ays	90 days
1	Control	21.67^{a}	85^{a}	145^{a}
2	Chinaberry	13.33^{b}	55^{bc}	75^{c}
3	Ginger	10^{bc}	63.33^{b}	106.67^{b}
4	Neem	8.33^{cd}	45^{c}	75^{c}
5	Sweet flag	6.67^{cde}	21.67^{d}	55^{cd}
6	Black pepper	6.07^{de}	10^{de}	33.33^{de}
7	Mustard oil	3.33^{e}	6.67^{e}	23.33^{e}
	Mean	9.91	40.95	73.33
	CV	24.993	17.87	20.13
	Lsd (0.05)	0.8545	2.56	5.16

As shown in Figure 1 highest number of dead cowpea weevils was recorded in mustard oil treatment application as 40 weevils followed by black pepper as 33.33 weevils, sweet flag 30 weevils and least in control as only 13.33 weevils after 90 days of treatment application.

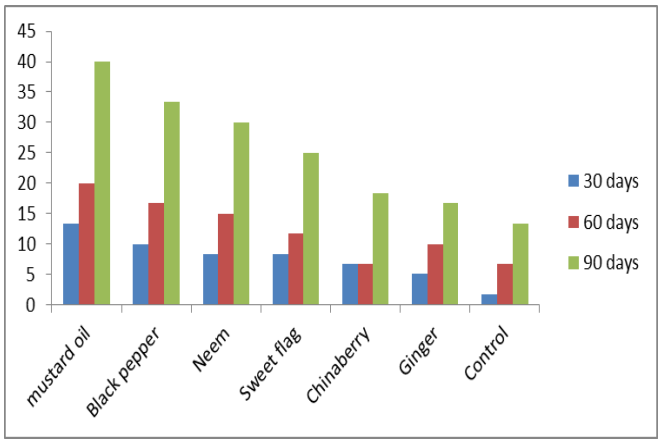

Fig 1: Comparative efficacy of different botanical pesticides on mortality of cowpea weevil in 100g seeds under different days of treatment in Dang, Nepal 2018.

Discussion

In this present study mustard oil was found the most effective botanical for the control of cowpea weevil. It is stated that in seeds of *Brassica juncea* active chemical constituents called 2-Phenylethyl isothiocyanate is present which reduces the fecundity rate of store insect pest [9]. It is also reported that mustard oil at 30 ml/kg of cowpea seed suppressed adult emergence of *C. maculatus* for up to 5 months [10]. It was also reported that rapeseed by-product was the most effective to control storage pest in maize [11]. Supporting this finding we also found minimum number of adult emergence in mustard oil treated seeds during our research period of 90 days. After mustard oil black pepper and sweet flag was effective to control the weevil. Similarly, it is found that black pepper (sabinene, limonene, d-carene, b-pinene, b-caryophyllene) were powerful biomaterial that repel the weevils from eating up grain endosperm and damaging grains [12]. Likewise, [13] reviewed about Sweet flag (*A. calamus*) properties as β-asarone which is the main substance that acts as insecticide and control weevil activities. Supporting these statements, our study also concluded that black pepper and Sweet flag are also efficient botanical pesticide to cause mortality of cowpea weevils and control their emergence followed by mustard oil. leaf of neem (*Azadiracta indica*), rhizome of ginger (*Zingiber officinale)*, leaf of Chinaberry tree (*Melia azedarach*), rhizome of sweet flag (*Acorus calamus*), mustard (*Brassica rapa*) oil and fruit of black pepper (*Piper nigrum*) were collected and let to them for shade dried for 48 hours Azadirachtin which is an active constituent of neem shows deterrent, anti-ovipositional, antifeedant, growth-disrupting and fecundity and fitness reducing properties [14]. Chinaberry (*Melia azadirach*) was reported for the ability to reduce the emergence of weevils, an ovicidal effect similar to that of synthetic insecticides caused by volatile compound (meliacarpine) coming from the extracts [15]. Ginger contains steroids and terpenoids (gingerol) which disrupt growth, show anti- ovipositional and cause death of *C. maculates* [16]. Supporting these statements, our study also concluded that botanical pesticides are effective for the management of cowpea weevils.

Conclusion

Different botanicals were found effective for the management of cowpea weevil (*C. maculates*). Mustard oil was found asthe best option to manage the storage insect in cowpea which is also harmless, environmental friendly as compare to chemical pesticides that is used to control storage pest.

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