

Original Research Article

Effect of desiccant beads on groundnut bruchid, *Caryedon serratus* (Olivier) infestation in stored groundnut.

ABSTRACT:

The purpose of this study was to evaluate the effect of desiccant beads on the stored groundnut against groundnut bruchid, *Caryedon serratus* Olivier. The experiment was carried out in the storage laboratory of Department of Entomology, OUAT, Bhubaneswar during 2019-20 in Completely Randomised Design. Groundnut pods (100 grams) in each treatment were mixed with 2 types of beads viz., zeolite beads and sodium aluminium silicate in four different ratios (1:1, 1:0.9, 1:0.8, 1:0.7) along with an untreated control and the observations on the fecundity, adult emergence, weight loss(%), moisture content, germination(%) were recorded during 6 months of storage at an interval of 60 days. Among the different treatments, the pods mixed with zeolite beads in 1:1 ratio was found to be the most superior treatment after 2, 4 and 6 months with the lowest fecundity (14.67, 25.67 and 34.33 eggs, respectively) and adult emergence (10.00, 17.33 and 25.00 adults, respectively). However, all the treatment dosages were found significantly superior over control which recorded maximum weight loss due to bruchid infestation. It was also noted that there was reduction in moisture content of the groundnut kernels with the increase of storage period with desiccant beads as these beads absorbed the moisture from the groundnut and created unsuitable environment for insect development and infestation. These beads did not show any adverse effects on the germination of groundnut.

Key words: *Groundnut, Desiccant beads, Groundnut bruchid, zeolite beads, Sodium aluminium silicate.*

1. INTRODUCTION:

Groundnut (*Arachis hypogaea* L.), is an important leguminous oilseed crop rich in nutrients. It is a rich source of edible oil and protein. The kernel consists of 48 to 50% oil and 26

to 28% protein (Bishiet *al.*, 2015). It is rich in oleic and linoleic acid which is about 75 to 80% of the total fatty acid content and carbohydrate content in groundnut ranges from 10 to 20% (Sakhareet *al.*, 2018). Groundnut being an important source of nutrition in human diet is stored as both pods and kernels and these are attacked by groundnut bruchid, *C. serratus* Olivier (Bruchidae: Coleoptera), which is considered as a major stored grain pest of groundnut. It causes damage both quantitatively and qualitatively. Kernels are found to be more susceptible to damage than pods during storage (Baribustaet *al.*, 2017). Storage of the pods after harvesting for a period of 5 to 6 months is very difficult due to the hidden infestation of bruchid in many groundnut producing states of India. The most important factors affecting the seed longevity in storage are seed moisture content and temperature (Ellis *et al.*, 1981).

The larvae of groundnut bruchid bore into the seed and feed upon the embryo and the endosperm. Final instar larvae come outside of the seed through the exit holes for pupation. Bruchid infestation causes considerable quantitative as well as qualitative losses to groundnut. This insect damage declines the quality of seed and oil, reduces its weight and nutritive value. Extent of damage (weight loss) caused by bruchid in shelled and unshelled groundnut is 70 and 80%, respectively and the extent of damage in tamarind is up to 79% (Sreedharet *al.*, 2020).

The effect of infestation of *C. serratus* on the biochemical components of groundnut was studied by (Sreedharet *al.*, 2020). The determination of quality loss of grains during storage is mandatory to determine the rate of physical and biochemical degradation in these grains. However, the post-harvest insect infestation severely affects quality and shelf-life of products (Patilet *al.*, 2020). The infestation due to stored grain insect pests also stimulates the growth of fungus as the moisture content of the seeds increases which in turn reduces the quality and viability of the seeds (KameswaraRao *et al.*, 2017). Desiccant-based drying can be more effective under these conditions and desiccants such as zeolite beads (Kamran *et al.*, 2020) and sodium aluminum silicate have been used for seed drying (Sultana *et al.*, 2021). Very limited work has been done to study their role in management of stored grain insect pests. Hence, the present study was carried out to evaluate the efficacy of desiccant beads *against* groundnut bruchid, *C. serratus* during storage condition.

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2. MATERIALS AND METHODS:

The present study on the management of groundnut bruchid by using zeolite and sodium aluminium silicate beads was carried out at the storage laboratory, Department of Entomology, College of Agriculture, OUAT, Bhubaneswar. Zeolite beads and sodium aluminium silicate were obtained from the dealers based out of Gujarat. Specifically the desiccant beads are modified ceramic sieve materials that absorb and hold water molecules very tightly in their microscopic pores. These beads continue to absorb moisture until all of their pores are filled, up to 20 to 25% of their initial weight. When placed in an enclosed plastic, glass or metal container, the desiccant beads remove water from the air, creating and maintaining a very low humid environment. Seeds placed into a container with the beads lose moisture due to low humidity in the air, and continue to do so until they come to equilibrium with the ambient air inside the container. Hence, drying using desiccant beads simply transfers the water in the seed to the drying beads through the air and there is no need for heating. These beads can be mixed with the seed or can be closed in a porous bag or cloth and kept in the hermetic container along with the seeds for the convenience of separation. The same beads can subsequently be removed and re-used after regeneration. Regeneration can be done separately by heating for 2 hours at 200°C to release the absorbed water. After heating, the beads should be immediately transferred to a moisture proof metal container with a lid (to reduce re-absorption of water) and kept until they are cooled.

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To study the effect of desiccant beads on *C. serratus* thoroughly dried 100 g of groundnut pods kept in sealed container were infested with five pairs of *C. serratus* 1 week prior to mixing with the zeolite/sodium aluminium silicate beads and replicated three times. The beads were tested at different concentrations comprising pod:bead ratios of 1:1, 1:0.9, 1:0.8 and 1:0.7. An untreated control was also maintained and the infestation of the pest was observed after 2, 4 and 6 months of storage and the data on fecundity, adult emergence, weight loss, moisture content due to infestation and germination per cent were recorded and analyzed statistically.

Comment [DSF5]: *C. serratus*,

3. RESULTS AND DISCUSSION:

The results were discussed under following headings.

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3.1 Efficacy of desiccant beads on fecundity of *C. serratus*

Efficacy of the zeolite beads and sodium aluminium silicate beads was evaluated by mixing the beads with groundnut pods of local variety cv. *Devi* at different concentrations (pod : bead

ratios) of 1:1, 1:0.9, 1:0.8 and 1:0.7. Those were kept in air tight containers at room temperature and the observation recorded on effect of desiccant beads on fecundity of *C. serratus* released in to the beads treated groundnut pods were presented in the Table 1.

The observation of fecundity of the bruchid on the groundnut pods treated with zeolite and sodium aluminium silicate beads after two months of storage marked superior performance of beads over the control. Among the different doses, pod:bead ratio of 1:1 and 1:0.9 were found significantly superior and recorded 18.00 and 22.50 eggs, respectively over other doses whereas the lower doses of 1:0.8 and 1:0.7 recorded 27.67 and 33.16 eggs, respectively. Between these two types of beads zeolite beads were more effective in reducing the fecundity of the bruchid (56.13 eggs) than sodium aluminium silicate beads (62.27 eggs). The interaction effect between beads and dosages revealed that among the different treatments, zeolite beads at 1:1 ratio exhibited most significant effect and recorded lesser number of eggs (14.67 eggs), whereas significantly high number of eggs (36.00 eggs) was recorded with sodium aluminium silicate beads at 1:0.7 ratio.

Comment [DSF7]: pod bead ratio

After four months of treatment the same trend continued and among the different doses used in the study on groundnut pods mixed with desiccant beads in the ratio of 1:1 and 1:0.9 reduced the fecundity to 28.67 and 37.50, respectively whereas 1:0.7 dosage was least effective and recorded 58.16 eggs. Out of these two beads used in the study zeolite beads restricted the fecundity to 99.00 whereas sodium aluminium silicate beads treatment resulted in 108.20 eggs. The interaction studies showed the superior performance of zeolite beads at 1:1 ratio where significantly the lowest number of eggs (25.67) were observed followed by sodium aluminium silicate beads at 1:1 ratio (31.67) eggs whereas significantly high fecundity (67.33 eggs) was observed in pods treated with sodium aluminium silicate beads at 1:0.7 ratio. All the treatments were found significantly superior over control which recorded 346.33 eggs.

After six months of treatment also pod:bead ratio at 1:1 showed superior performance by recording lesser number of eggs (38.33) whereas at 1:0.7 ratio was least effective and recorded 78.33 eggs. Zeolite beads continued to be the most effective treatment and recorded 156.27 eggs whereas sodium aluminium silicate beads treatment recorded 161.93 eggs. The interaction effect between beads and dosages revealed that the zeolite beads mixed with the groundnut pods in 1:1 ratio proved to be the most effective in restricting the eggs to 34.33, whereas, significantly high fecundity (80.00 eggs) was observed in the treatment mixed with sodium aluminium silicate beads in 1:0.7 ratio.

Comment [DSF8]: pod bead

		m silicate		silicate		silicate		silicate		
T ₁ (Pods : Beads)	1:1	14.67 (3.96)	21.33 (4.72)	18.00 (4.34)	25.67 (5.16)	31.67 (5.71)	28.67 (5.43)	34.33 (5.94)	42.33 (6.58)	38.33 (6.22)
T ₂ (Pods : Beads)	1:0.9	17.33 (4.28)	27.67 (5.35)	22.50 (4.81)	33.67 (5.89)	41.33 (6.51)	37.50 (6.20)	48.67 (7.05)	53.33 (7.37)	51.00 (7.21)
T ₃ (Pods : beads)	1:0.8	23.67 (4.97)	31.67 (5.71)	27.67 (5.34)	40.33 (6.43)	54.33 (7.44)	47.33 (6.93)	56.33 (7.57)	68.67 (8.35)	62.5 (7.96)
T ₄ (Pods : Beads)	1:0.7	30.33 (5.60)	36.00 (6.08)	33.16 (5.84)	49.00 (7.07)	67.33 (8.27)	58.16 (7.67)	76.67 (8.81)	80.00 (9.00)	78.33 (8.90)
T ₅ – Control		194.67 (13.99)		194.67 (13.99)	346.33 (18.64)		346.33 (18.64)	565.33 (23.80)		565.33 (23.80)
Mean		56.13 (6.56)	62.27 (7.17)		99.00 (8.64)	108.20 (9.31)		156.27 (10.63)	161.93 (11.02)	
		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)	
Type of Beads (F₁)		0.041	0.12		0.044	0.13		0.035	0.10	
Dosage (F₂)		0.065	0.19		0.069	0.21		0.055	0.16	
Interaction (F₁X F₂)		0.091	0.27		0.098	0.29		0.078	0.23	

Figure in parentheses are square root transformed values MAT- Months after treatment

3.2 Efficacy of desiccant beads on adult emergence of *C. serratus*

The results obtained on the effect of desiccant beads on the adult emergence of *C. serratus* were presented in the Table 2.

The observation on adult emergence of *C. serratus* obtained from groundnut pods treated with desiccant beads found to be significantly superior over the untreated control (Table 2). None of

		silicate		silicate		m silicate				
T ₁ (Pods :Beads)	1:1	10.00 (3.31)	14.67 (4.72)	12.33 (4.01)	17.33 (4.28)	23.33 (4.93)	20.33 (4.60)	25.00 (5.09)	34.67 (5.97)	29.83 (5.53)
T ₂ (Pods :Beads)	1:0.9	12.33 (3.64)	20.67 (5.35)	16.50 (4.49)	21.67 (4.75)	28.00 (5.38)	24.83 (5.06)	34.33 (5.94)	45.33 (6.80)	39.83 (6.37)
T ₃ (Pods :Beads)	1:0.8	17.00 (4.23)	25.33 (5.71)	21.16 (4.97)	32.00 (5.74)	42.33 (6.58)	37.16 (6.16)	46.00 (6.85)	56.00 (7.55)	51.00 (7.20)
T ₄ (Pods :Beads)	1:0.7	22.33 (4.83)	30.33 (6.08)	26.33 (5.45)	40.33 (6.43)	50.67 (7.19)	45.50 (6.81)	60.33 (7.83)	69.33 (8.38)	64.83 (8.10)
T ₅ – Control		128.67 (11.38)		128.67 (11.38)	275.67 (16.63)		275.67 (16.63)	404.67 (20.14)		404.67 (20.14)
Mean		38.06 (5.48)	43.93 (6.65)		77.40 (7.56)	84.00 (8.14)		114.06 (9.17)	122.00 (9.77)	
		SE(m)±	CD (P=0.05)	SE(m)±	CD (P=0.05)	SE(m)±	CD (P=0.05)	SE(m)±	CD (P=0.05)	
Type of Beads (F₁)		0.071	0.21	0.062	0.18	0.061	0.18			
Dosage (F₂)		0.112	0.33	0.098	0.29	0.096	0.29			
Interaction (F₁X F₂)		0.158	0.47	0.138	0.41	0.136	0.40			

Figure in the parentheses are square root transformed values MAT- Months After Treatment

The present findings are in agreement with El-Bakry *et al.* (2019) who observed that Ag-loaded 4A-zeolite beads were highly effective with less adult emergence and high adult mortality of rice weevil (*Sitophilus oryzae*) and lesser grain borer (*Rhyzoperthadominica*) due to high moisture absorbing capacity. Similar findings were also reported with Jyothsna (2014) where significantly less weight loss with pod:bead ratio of 1:1 was found while 1:0.7 pod:bead ratio resulted in significantly high weight loss. The present results are in conformity with the findings of Bidyarani (2013). They also observed minimum number of *C. chinensis* adults in greengram seeds treated with zeolite beads at 1:1 ratio and the adult emergence increased with decrease in the bead ratio to 1:0.7. The results also support the experiments of Lakshmi Prasad (2013). He found less *C. chinensis* adult emergence in zeolite beads mixed with greengram seeds in

Comment [DSF12]: El-Bakry *et al.* 2019

Comment [DSF13]: experiments

T ₁ (Pods :Beads)	1:1	3.52	4.48	4.00	6.74	9.57	8.15	12.56	13.54	13.05
T ₂ (Pods : Beads)	1:0.9	4.23	5.75	4.99	7.92	11.92	9.92	14.63	15.68	15.15
T ₃ (Pods : Beads)	1:0.8	5.16	6.94	6.05	9.04	13.74	11.39	16.61	17.42	17.01
T ₄ (Pods : Beads)	1:0.7	6.62	7.83	7.22	11.15	15.06	13.11	19.47	21.24	20.35
T ₅ – Control		27.78			58.63			76.43		
Mean		9.46	10.56		18.69	21.78		27.94	28.86	
		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)	
Type of Beads (F₁)		0.288	0.86		0.304	0.90		0.324	N.S.	
Dosage (F₂)		0.455	1.35		0.480	1.43		0.513	1.52	
Interaction (F₁X F₂)		0.644	N.S.		0.679	2.02		0.725	N.S.	

N.S.- Not significant

MAT- Months after treatment

statistically at par with each other. The pods stored with zeolite beads resulted in 27.94% weight loss whereas with sodium aluminium silicate beads it was 28.86%. The interaction effect of dosages and beads was found non-significant. The control recorded 76.43% weight loss during six months of storage.

The results obtained on the effect of desiccant beads on the developmental biology and infestation by *C. serratus* in the pods of groundnut proves that though the beads could not provide complete control of pest, the development of pest and subsequent damage caused by it was significantly reduced when the pods were mixed with beads in 1:1 ratio. Among the beads, zeolite beads proved more effective over sodium aluminium silicate beads. These beads absorbed the moisture from the pods and created unsuitable environment for insect development and infestation. Sultana *et al.* (2021) supported the present findings where the greengram seeds mixed with sodium aluminium silicate beads and zeolite beads resulted in significantly less weight loss after 6 months of storage. The present findings are also in

		Zeolite beads	Sodium aluminium silicate		Zeolite beads	Sodium aluminium silicate		Zeolite beads	Sodium aluminium silicate	
T ₁ (Pods :Beads)	1:1	5.31	5.61	5.46	4.24	4.48	4.36	3.37	3.81	3.59
T ₂ (Pods :Beads)	1:0.9	5.38	5.67	5.52	4.31	4.61	4.46	3.43	3.88	3.65
T ₃ (Pods :Beads)	1:0.8	5.44	5.76	5.60	4.39	4.77	4.58	3.67	3.93	3.80
T ₄ (Pods :Beads)	1:0.7	5.51	5.85	5.68	4.46	4.85	4.65	3.74	3.97	3.85
T ₅ – Control		14.35		14.35	13.65		13.65	12.84		12.84
Mean		7.20	7.45		6.21	6.47		5.41	5.69	
		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)	
Type of Beads (F₁)		0.040	0.12		0.046	0.14		0.061	0.18	
Dosage (F₂)		0.023	0.07		0.026	0.08		0.013	0.04	
Interaction (F₁X F₂)		0.049	N.S.		0.053	0.16		0.071	N.S.	

MAT- Months after treatment

N.S.- Not significant

From the findings it was observed that there was decrease in moisture content of the groundnut kernels with the increase of storage period with desiccant beads. The initial moisture content of the groundnut kernels reduced from 11.37% to 5.31%, 4.24%, and 3.37% after 2, 4 and 6 months of storage, respectively when zeolite beads were mixed with the pods in 1:1 ratio. On the other side, sodium aluminum silicate beads mixed with the pods at 1:1 ratio resulted in reduction of the moisture content to 3.59% after 6 months of storage. The maximum reduction in moisture content was obtained by the zeolite beads which might be due to their highly polar surface within the pores which is the major reason for moisture adsorption from the seeds.

A zeolite-based desiccant, called drying beads, has also been employed for use in drying seeds and agricultural commodities (Kamran *et al.*, 2020). As the desiccant absorbs water from the air inside the container, the relative humidity (RH) decreases and water evaporates from the seeds until the desiccant capacity is saturated or the system comes to equilibrium. A benefit of drying

beads is that water is held very tightly in its pores, rapidly lowering the RH to very low levels. In addition to it, its water holding capacity is essentially the same regardless of the RH. This present findings are in partial accordance with Sultana *et al.*,(2021) where the zeolite beads were capable of drying the greengram seeds from 10% to near 6% moisture content within 6 months of treatment, but sodium aluminum silicate and activated alumina were slower to equilibrate.

Similar results were obtained with the findings of Nivethitha *et al.*,(2020) where the okra seeds and zeolite beads were taken in the ratio of 1:0.5, 1:1, 1:2 and 1:3 and after 120 hour the highest moisture elimination was noticed in seeds dried with zeolite beads (4.59%) in 1:3 ratio. Jyothisna (2014) also observed that with increase of storage period with desiccant beads there was decrease in kernel moisture content and among the different treatments groundnut pods mixed with sodium aluminium silicate beads in 1:0.8 and 1:0.7 ratio recorded significantly high moisture content after 6 months of storage and. The results are having resemblance with the findings of Lakshmi Prasad (2013), who reported that the greengram seeds mixed with zeolite beads at 1:1 ratio reduced the initial moisture content of 10.20% to 6.22 %, 6.19 %, 6.15 %, 6.13 %, 6.10 % and 6.07 % after 1, 2, 3, 4, 5 and 6 months of storage respectively. Similarly, Bidyarani (2013) also reported that the initial moisture content of greengram seeds mixed with zeolite beads (1:1 ratio) was reduced to 9.26% at 1 MAT, 7.69% at 2 MAT and 5.76% at 3 MAT in air tight container. Keshavulu *et al.*, (2012) also noticed that zeolite bead technology was able to reduce the *C.chinensis* damage in greengram during storage by bringing down the moisture content to 3.7%. The present results are in agreement with Hay *et al.*, (2012) who emphasized that moisture content of the seeds depends on the ratio of the beads to seeds and reported that zeolite beads had reduced the moisture content of rice seeds to 4.2% after long term storage.

Comment [DSF14]: results of this study are also in line with the findings

3.5 Effect of desiccant beads on germination of groundnut kernels:

The observations on the effect of desiccant beads on germination per cent of groundnut kernels after 2, 4 and 6 months of storage are presented in the table 5.

The observations taken after two months of treatment revealed that the highest germination was observed in T₁ and T₂ treatments with pod and bead ratio of 1:1 (87.00%) and 1:0.9 (85.33%) were found at par with each other. The dosages used at 1:0.8 and 1:0.7 ratio recorded comparatively less germination percentage (83.66% and 81.67%) than the higher doses. The per cent germination of groundnut kernels was highest in zeolite beads treated pods (82.60%)

than sodium aluminum silicate beads (81.40%). The interaction effects between the doses and the beads did not show any significant effect on seed germination.

After four months of treatment also the same dosages of pod and bead ratios of 1:1 and 1:0.9as continued to show superior performance where the germination percentage was recorded as 78.83% and 76.83% respectively, whereas a lower germination percentage of 74.00% and 71.67% were found at the dosages of 1:0.8 and 1:0.7, respectively. Significantly the lowest germination was recorded in control (53.33%). The interaction effect between pods and dosages did not show any significant effect on germination of groundnut.

The germination per cent observed after six months of treatment showed similar trend in which pod and bead ratios of 1:1 and 1:0.9 were superior and recorded 72.50% and 71.00% germination, respectively in contrast to 69.33% and 67.50% germination recorded in the lower doses of 1:0.8 and 1:0.7. Again the interaction effect between doses and beads were found non-significant. However, the untreated control recorded only 34.67% germination.

The results obtained from the present investigations on the effect of desiccant beads on germination of groundnut kernels indicated that the desiccant beads mixed with the kernels did not affect the germination per cent drastically during six months of storage. The present findings are in line with Nivethithaet *al.*, (2020), where germination test revealed no reduction in germination percentage and no hard seed formation even in 1:3 ratio of seeds with zeolite beads. Jyothisna (2014) also supported the present results and reported that beads treated with groundnut did not affect the germination percent drastically even after 9 months of storage. However, pod and bead ratios of 1:1 and 1:0.9 were superior and recorded 72.50% and 71.33% germination, respectively in contrast to 69.50% and 67.67% germination observed in lower doses of 1:0.8 and 1:0.7. The results are in close proximity with the findings of Sultana *et al.* (2021) where the seed germination percentages of greengram declined in association with the increase in damage to stored seeds inoculated with pulse beetle. Germination percentage of greengram seeds declined from 98% to 79% during 6 months of storage. The decrease in germination per cent of groundnut seeds in all the treatments with increase in storage period could be due to increase in pest infestation over the period and decreased vigour of the seed with increased storage period. Similar type of result was found with Lakshmi Prasad (2013) where germination percentage of greengram seed was declined after 6 months of storage as compared to initial germination to an extent of 7.1 %, 8.1 % and 9.1 % when treated with zeolite beads, silica gel and sodium aluminium silicate beads, respectively. Raja *et al.*, (2004) also

reported that there was a significant reduction in germination (9.26%) of greengram seeds with an increase in level of bruchid infestation.

Table 5 :Effect of desiccant beads on germination(%) of groundnut kernels

Treatment	Dosage	Germination(%)								
		2MAT			4MAT			6MAT		
		Zeolite beads	Sodium aluminium silicate	Mean	Zeolite beads	Sodium aluminium silicate	Mean	Zeolite beads	Sodium aluminium silicate	Mean
T ₁ (Pods :Beads)	1:1	87.67 (9.42)	86.33 (9.35)	87.00 (9.38)	80.33 (9.02)	77.33 (8.85)	78.83 (8.93)	73.67 (8.64)	71.33 (8.50)	72.50 (8.57)
T ₂ (Pods :Beads)	1:0.9	86.00 (9.33)	84.67 (9.26)	85.33 (9.29)	78.00 (8.89)	75.67 (8.75)	76.83 (8.82)	72.00 (8.54)	70.00 (8.43)	71.00 (8.48)
T ₃ (Pods :Beads)	1:0.8	84.33 (9.24)	83.00 (9.17)	83.66 (9.20)	76.33 (8.79)	74.00 (8.66)	75.16 (8.72)	71.33 (8.50)	67.33 (8.27)	69.33 (8.38)
T ₄ (Pods :Beads)	1:0.7	82.67 (9.15)	80.67 (9.04)	81.67 (9.09)	73.67 (8.64)	71.67 (8.52)	72.67 (8.58)	69.33 (8.39)	65.67 (8.16)	67.50 (8.27)
T ₅ – Control		72.33 (8.56)		72.33 (8.56)	53.33 (7.37)		53.33 (7.37)	34.67 (5.97)		34.67 (5.97)
Mean		82.60 (9.14)	81.40 (9.07)		72.33 (8.54)	70.40 (8.43)		64.20 (8.01)	61.80 (7.87)	
		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)		SE(m)±	CD (P=0.05)	
Type of Beads (F ₁)		0.025	N.S.		0.035	0.10		0.041	0.12	
Dosage (F ₂)		0.040	0.12		0.055	0.16		0.065	0.19	
Interaction (F ₁ X F ₂)		0.056	N.S.		0.078	N.S.		0.091	N.S.	

Figure in parentheses are angular transformed values MAT- Months after treatment N.S.- Not significant

4. CONCLUSION:

In the present study, two types of desiccant beads were used viz., zeolite beads and sodium aluminium silicate beads to test their efficacy against *C. serratus* in four different pod:bead ratios (1:1, 1:0.9, 1:0.8 and 1:0.7). The findings indicated that though none of the treatments

Comment [DSF15]: pod bead

completely gave cent per cent protection to the groundnut pods from pest infestation, but reduced the moisture content of the kernels thus having adverse effect on the biology of the insect-pest and reduced the pod infestation and damage pods. Among the different dosages pods mixed with zeolite beads in 1:1 ratio was found significantly superior over other treatments. However, the beads did not show any adverse effects on the germination of groundnut.

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