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Predation potential of stink bug, *Alcaeorrhynchus grandis* against pod borer complex of pigeonpea, *Cajanus cajan* (L) Millsp under laboratory

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Abstract
Background: Among pulse crops, pigeonpea is easily grown in drought and grows large. Under biotic stresses, insect attack is the biggest problem in pigeonpea production. In order to stop this from happening, farmers use a lot of pesticides. Due to insecticides' residual toxic effect, they have a direct negative effect on their natural enemies in the pigeon pea ecosystem. It directly affects natural or biological control by affecting predation abilities.
Methods: For feeding efficacy of, all the larval stages and pupae of leaf webber, pod borer, blue butterfly, and plume moth were released in trebly petri dish and each stage of predator, *Alcaeorrhynchus grandis*. Count the rest of the individuals in petri dishes to determine prayer efficacy after consumption.
Result: The stink bug, *Alcaeorrhynchus grandis*, was just as aggressive towards its prey as it was sensitive to insecticides. It accomplished hunting at all stages of its life and with its prey. Ninety percent of the population of 3rd instar pod borer larvae, pupa of the blue butterfly, 3rd, 4th, and 5th instar plume moth larvae, and 83.85% of the population of 2nd instar leaf webber larvae were killed by the adult stage of the stink bug.

Keywords: *Alcaeorrhynchus grandis*, insecticidal toxicity, pigeonpea

Introduction
India produces an estimated 4315.90 thousand tonnes of pigeonpea from an area of 4724.45 thousand hectares. Based on the area, Karnataka State is in first position and holds 34.52% of it. Based on production, Maharashtra ranks first, contributing 30.76% to the total production of pigeonpea in India, while Madhya Pradesh (1305 kg/ha) ranks first nationally on production capacity (Fig.1). Over the last decade, fluctuations have been seen in production and productive capacity (Fig.2). Pest attacks cause 30% losses to pulse crops every year (ICAR-IIPR Vision 2050). Pathade *et al.* (2015) [1] reported that about 250 insect species attacked on pigeonpea crop. Minja *et al.* (2000) [2] found that most pigeon pea crops were damaged by pod borers (*Helicoverpa armigera*, *Maruca vitrata*, *Etiella zinckenella* and *Lampides boeticus* at Kiboko, and *H. armigera* at Kabete), pod-sucking bugs (*Clavigralla tomentosicollis*) and pod flies (*Melanagromyza chalcosoma*). Khajuria *et al.* (2015) [3] conducted a survey on pigeonpea crop in Panchmahal district of Gujarat and a total of 8 species of predators were recorded. Coleoptera, Hymenoptera, Dictyoptera, Araneida, and Neuroptera were the main predators recorded. A predatory stink bug, *Alcaeorrhynchus grandis* (Dallas) (Coleoptera: Pentatomidae) occurs in several rows of crops and preys on other insects, particularly larvae of Lepidoptera (Richman and Mead, 2011) [4]. Pal *et al.* (2022) [6] recorded hyper predatory interaction between *Alcaeorrhynchus grandis* and lady bird beetle, *Coccinella septumpunctata* in brinjal crop. *Alcaeorrhynchus grandis* caused 50 percent of the grub population and 100 percent of the pupae to die. However, considering plant protection, if pesticides are crystallized, they will not be polluted the environment, nor will there be a reduction in the number of predatory, parasitic, and parasitoids insects.

Material and Methods
Alcaeorrhynchus grandis was reared in the laboratory, Rani Lakshi Bai Central Agriculture University, Jhansi (UP), India. The eggs of *A. grandis* were placed in three replicates on separate Petri dishes (15 cm in diameter) to determine its feeding potential. Pod borer, leaf webber, blue butterfly, and plume moth were reared in insect-rearing cages on host plant parts.

During the study period, all the larval stages (1st, 2nd, 3rd, 4th, 5th) and pupae of leaf webber, pod borer, blue butterfly, and plume moth were released in 10 numbers in each petri dish, and each stage of predator (1st, 2nd, 3rd nymphal and adult). To assess the mortality rate of the prey based on the individual's death. Controls consisted only of rearing different insect stages without a predator.

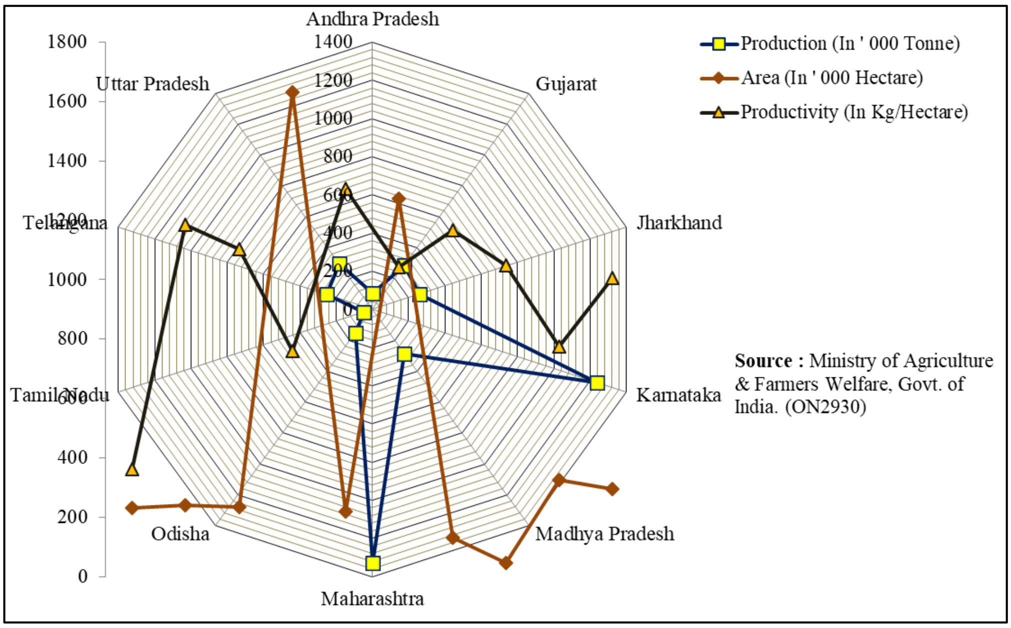

Fig 1: Top ten State-wise Area, Production and Productivity of Arhar (Tur) in India (2020-2021).

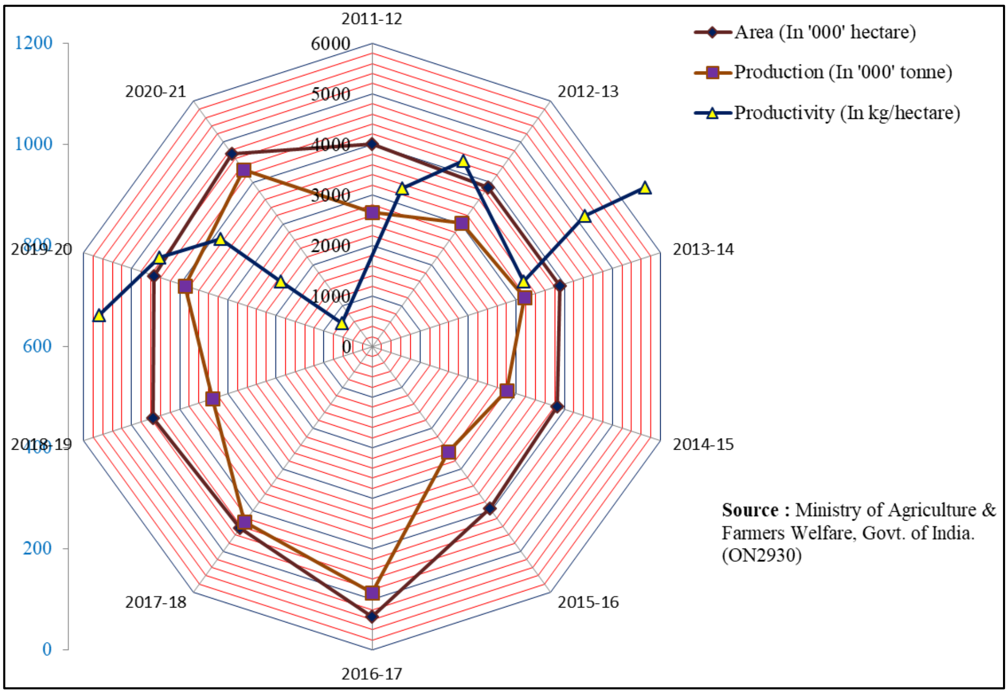

Fig 2: Last ten year, area, production and productivity of Arhar (Tur) in India (2020-2021)

Result and discussion

Feeding efficacy of *Alcaeorrhynchus grandis* against leaf webber, *Maruca vitrata*

Based on the feeding efficacy of the predator, was recorded based on consumed larvae after being released in a petri dish. The adults of sting bugs were the most likely to feed and the nymphs were the most likely to rest. The first instar caterpillars of the leaf webber did not bother the adult sting bug. The maximum prey mortality rates at the 1st, 2nd, 3rd, 4th, and 5th instar larvae were 46.99±5.17, 83.85±6.16, 77.69±6.16, 39.13±3.40, 41.05±3.93, and 41.14±1.92%, respectively, due to adult of sting bugs (table 1). Ali and Rizvi (2007) [6] studied the feeding performance of the ladybird beetle against different species of aphids under laboratory conditions. Grubs consumed most *H. coriandri*, while adults preferred *L. erysimi*. The last larval stage (grub 4), irrespective of aphid species, consumed more aphids than the other grub stages. Overall predation by *C. septempunctata* was significantly higher on *L. erysimi* than on other species.

Table 1: Pooled feeding efficacy of *Alcaeorrhynchus grandis* against Leaf webber, *Maruca vitrata*

Life stage of predator	Mortality percent in population (Mean±SE)					
	Life stage of insect pest					
	1st instar	2nd instar	3rd instar	4th instar	5th instar	Pupae
1st instar	41.14*±1.92	23.85±2.71	21.14±2.71	14.99±7.86	6.14±6.14	6.14±6.14
2nd instar	46.99±5.17	55.05±5.39	26.06±4.27	23.85±2.71	14.99±7.86	26.06±4.27
3rd instar	44.98±3.33	68.83±2.71	50.83±3.40	30.98±2.21	28.07±6.05	32.99±3.66
Adult	26.06±4.27	83.85±6.16	77.69±6.16	39.13±3.40	41.05±3.93	41.14±1.92
Control	23.85±2.71	21.14±2.71	12.29±6.14	12.29±6.14	6.14±6.14	6.14±6.14
C.D.	11.687	13.461	15.158	14.222	20.840	15.023
SE(m)	3.661	4.217	4.749	4.456	6.529	4.707
SE(d)	5.178	5.964	6.716	6.302	9.234	6.656
C.V.	17.326	14.452	21.876	34.336	53.725	36.241

Feeding efficacy of *Alcaeorrhynchus grandis* against pod borer, *Helicoverpa armigera*

The consumption rate at the first nymphal stage of stink bugs against the first, second, third, fourth, fifth instars, and the pupal stage was not at par followed by the second, third, and adult stage. The prey consumption rate at the third nymphal stage was highest against the 2nd instar larvae of pod borer followed by 4th, 3rd, 5th, pupae, and 1st (table 2). An adult sting bug was most likely to consume the *Helicoverpa armigera* third instar. The fourth and fifth instar, on the other hand, were more likely to confront each other. In our study, no such references were found, but some cross-references suggest that the study is similar. Ünal *et al.* (2017) [7] determine the predatory efficacy of *Coccinella septempunctata* Linnaeus (Coleoptera: Coccinellidae) on *Macrosiphum rosae* (Linnaeus). There was consumption of 20.3, 54.3, 108.2, and 232.7 *M. rosea* by the first, second, third, and fourth larval instars of *C. septempunctata*, respectively. From the first to the fourth larval instar, *C septempunctata* exhibited increased predation efficacy. In order to design a long-term management strategy for *H. armigera*, Ahmad's (2003) [8] assessment of natural enemies—including parasitoids, predators, and microbiological pathogens—will be helpful.

Table 2: Pooled feeding efficacy of *Alcaeorrhynchus grandis* against pod borer, *Helicoverpa armigera during*

Life stage of predator	Mortality percent in population (Mean±SE)					
	Life stage of insect pest					
	1st instar	2nd instar	3rd instar	4th instar	5th instar	Pupae
1st instar	28.77±2.21	26.06±4.27	30.28±6.18	21.14±2.71	21.14±2.71	23.85±2.71
2nd instar	61.69±4.92	48.91±5.15	32.99±3.66	34.91±5.39	28.77±2.21	39.13±3.40
3rd instar	44.98±10.64	74.98±7.87	63.90±4.27	68.83±2.71	46.99±5.17	50.83±3.40
Adult	36.13±11.16	83.85±6.16	90.00±0.00	74.98±7.87	56.98±3.66	63.90±4.27
Control	28.77±2.21	23.85±2.71	14.99±7.86	12.29±6.14	12.29±6.14	12.29±6.14
C.D.	23.536	17.590	16.366	17.089	13.543	13.272
SE(m)	7.374	5.511	5.128	5.354	4.243	4.158
SE(d)	10.428	7.794	7.251	7.572	6.001	5.881
C.V.	31.876	18.525	19.127	21.857	22.116	18.954

Feeding efficacy of *Alcaeorrhynchus grandis* against blue butterfly, *Lampides boeticus*

The first, second, third, and adult stages of the stink bug killed the maximum amount of the pupa stage of the blue butterfly. The primary reason was that the pupa was inactive. Stink bugs were observed to be very agile during all phases of attack, and when attacking their prey, they used to pierce their bodies from a distance. The third nymphal stage of the stink bug kills the first and second instar caterpillars. The adult predators consumed a maximum of third, fourth, and fifth instar larvae (table 3). In our study, no such references were found, but some cross-references suggest that the study is similar. Pal and Bhatt (2018) [9] investigated the feeding efficiency of six species of ladybird beetles on mustard aphids, *Lipaphis erysimi*. There were maximal numbers of aphids consumed throughout the larval and adult stages. The aphid consumption increased with the change in the larval life cycle traits. It was highest at 4th instar larvae and least at 1st instar larvae for all the studied species. A new kind of parasitoid-host interaction was seen and experimental evidence for it was provided by Obregón *et al.* (2012) [10]. The parasitoid cocoons that the larvae of *Lampides boeticus* (Lepidoptera) and *Cotesia specularis* (Hymenoptera) uncover are easily killed and consumed. Potential impacts are briefly described for both the individual and population levels.

Table 3: Pooled feeding efficacy of *Alcaeorrhynchus grandis* against blue butter fly, *Lampides boeticus*

Life stage of predator	Mortality percent in population (Mean±SE)					
	Life stage of insect pest					
	1st instar	2nd instar	3rd instar	4th instar	5th instar	Pupae
1st instar	36.83±7.22	42.77±8.79	37.13±3.93	36.63±10.07	41.14±1.92	59.19±4.22
2nd instar	32.99±3.66	55.05±5.39	50.83±3.40	49.12±8.76	53.05±5.44	61.98±6.05
3rd instar	46.99±5.17	67.84±11.08	74.98±7.87	77.69±6.16	66.61±4.92	68.83±2.71
Adult	23.85±2.71	66.12±2.71	81.14±8.86	83.85±6.16	83.85±6.16	90.00±0.00
Control	23.85±2.71	14.99±7.86	12.29±6.14	12.29±6.14	6.14±6.14	6.14±6.14
C.D.	14.752	24.645	20.447	24.376	16.472	14.236
SE(m)	4.622	7.721	6.406	7.637	5.161	4.460
SE(d)	6.536	10.919	9.060	10.801	7.298	6.308
C.V.	24.332	27.097	21.641	25.481	17.821	13.503

Feeding efficacy of *Alcaeorrhynchus grandis* against plume moth, *Exelastis atomosa*

Plume moth larvae were small and moved slowly on plant parts. The larvae feed on flower parts and pupate mostly naked. The third nymphal stage of the predator was observed to be the most lethal against the first stage of the plume moth caterpillar. This was the reason 63.90 percent of the caterpillar population was eaten and killed. In contrast, the adult stage of the predator kit was effective at all other stages of the plume moth (table 4). During the investigation, the inactive phase of the life of the blue butterfly and plume moth was severely attacked by the first nymph and adult stages of stink bugs. The main reason for this is that they are small and easily caught and killed by predators. Flint and Steve (2005) [11] reported that a single release of 100 lady beetles controlled 66– 88% of aphid control during their study. The predatory ability of *C. sexmaculata* on *A. gossypii* taken from cotton leaves at 25 °C has also been researched by Babu (2001) [12]. In contrast to the current observation, he has stated that the grubs of *C. sexmaculata* nourished a total of 295.96 nymphs of A. gossypii during their growth.

Table 4: Pooled feeding efficacy of *Alcaeorrhynchus grandis* against plume moth, *Exelastis atomosa*

Life stage of predator	Mortality percent in population (Mean±SE)					
	Life stage of insect pest					
	1st instar	2nd instar	3rd instar	4th instar	5th instar	Pupae
1st instar	50.83±3.40	56.98±3.66	47.20±8.79	44.98±3.33	43.06±1.92	66.12±2.71
2nd instar	61.98±6.05	61.90±6.05	61.69±4.92	54.76±2.01	59.98±7.86	72.27±8.86
3rd instar	63.90±4.27	66.12±2.71	83.85±6.16	83.85±6.16	77.69±6.16	83.85±6.16
Adult	52.75±2.01	83.85±6.16	90.00±0.00	90.00±0.00	90.00±0.00	90.00±0.00
Control	23.35±4.92	21.14±2.71	14.99±7.86	14.99±7.86	6.14±6.14	12.29±6.14
C.D.	13.888	13.925	20.243	15.287	16.950	18.140
SE(m)	4.351	4.363	6.342	4.789	5.311	5.683
SE(d)	6.153	6.170	8.969	6.773	7.510	8.038
C.V.	14.909	13.153	18.448	14.373	16.611	15.167

Conclusion

The stink bug consumed more larval stages of the leaf webber and pod borer than the blue butterfly and plume moth due to its predation behaviour. The third stage of the predator's killing rate was significantly higher than the rest of the larval stages. It was observed to hunt prey more effectively as an adult. Despite the fact that the blue butterfly and plum moth larvae and pupae were both small, the stink bug was able to capture and kill them. However, leaf webber and pod borer larvae fought back.

References

1. Pathade MP, Salunke PB, Borker SL. Evaluation of some insecticides against pigeonpea pod fly *Melanagromyza obtusa* Mall. Indian journal of agricultural research. 2015;49(5):460-463.
2. Minja EM, Shanower TG, Silim SN, Karuru O. Efficacy of different insecticides for pigeonpea pest management in Kenya. International Chickpea and Pigeonpea Newsletter. 2000;7:53-55.
3. Khajuria S, Rai AK, Lata K, Jadav JK. Prevalence of major insect pests and predators of pigeon pea (*Cajanus cajan* L.) in Middle Gujarat. Journal of. Krishi Vigyan. 2015;3(2):73-77.
4. Richman DB, Mead FW. Predatory Stink Bug, *Alcaeorrhynchus grandis* (Dallas) (Hemiptera: Pentatomidae). University of Florida. Online published on 2011; at: https://www.researchgate.net/publication/237638561
5. Pal S, Chaturvedi SK, Baskar DC, Kumar P, Patel AK, Parmar A, *et al*. *Alcaeorrhynchus grandis* and *Oomyzus scaposus*: Natural enemies of *Coccinella septumpunctata* in Bundelkhand. The Pharma Innovation Journal. 2022;SP-11(2):820-824.
6. Ali A, Rizvi PQ. Development and predatory performance of *Coccinella septempunctata* L. (Coleoptera: Coccinellidae) on different aphid species. J. Bio. Sci., 2007;7(8):1478-1483.
7. Unal S, Er A, Akkuzu E, Šálek L. Predation Efficacy of the Predator Coccinella septempunctata L. on the Aphid Species *Macrosiphum rosae* (L.) in Kastamonu Province, Turkey. Pakistan Journal of Zoology. 2017;49(1):327-330.
8. Ahamad M. A checklist of natural enemies of Helicoverpa armigera (HÜBNER). Journal of Agricultural Research. 2003;41(3-4):267-278.
9. Pal S, Bhatt J. Feeding Efficiency of Six Beetle Species against Mustard Aphid, *Lipaphis erysimi* (Kalt.) in

Uttarakhand, India. International Journal of Current Microbiology and Applied Sciences. 2018;7(04):1970-1976.
10. Obregon R, Guijarro A de H, Barbudo DJ, Haeger JF. *Lampides boeticus* (Lepidoptera: Lycaenidae) Preys on Cocoons of its Own Specific Parasitoid *Cotesia specularis* (Hymenoptera: Braconidae). Journal of Insect Behavior. 2012;25:514-517.
11. Flint ML, Steve HD. Interactions among convergent lady beetle (*Hippodamia convergens*) releases, aphid populations, and rose cultivar. Biological Control. 2005;34:38-46.
12. Babu A. Influence of prey species on feeding preference, post- embryonic development and reproduction of *Coccinella transversalis* F. (Coleoptera: Coccinellidae). Entomon. 1999;24(3):221-228.