

## Pollinators and visitors of *Amorphophallus napalensis* (Wall.) Bogner & Mayo (Araceae) in Nagaland state, North-east India

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### Abstract

Studies on insect visitors of *Amorphophallus napalensis* (Wall.) Bogner & Mayo have been conducted at two sites viz., Lumami (in wild), district Zunheboto and Arkong ward of Mokokchung district (in cultivation) of the Nagaland state in North-east India) which are situated at two different localities with altitudinal variation of 900 and 1350 m amsl respectively. The flowers of *A. napalensis* are self incompatible and require pollens from the anthers (male flowers) of nearby growing individuals. The insect visitors, viz., beetles of genus *Parastasia* (Scarabaeidae), honey bees *Apis indica* (Apidae), sting less bees *Trigona* sp. (Apidae) and fruit flies of genus *Drosophila* (Drosophilidae) have been observed to forage the inflorescences of *A. napalensis* at both the sites of investigation. Out of these visitors, honey bees (*Apis indica*) and *Trigona* sp. have been found to collect pollen grains, whereas, beetles were found to devour the pollens of male flowers as well as axis of the inflorescences and at the same time also transfer pollen grains on the stigmas of female flowers in the process of hiding at the base of the spadix. However, the *Drosophila* sp. was seen to roam around the male flowers only.

**Key words:** Insect visitors, Pollinators, Behaviour, *Amorphophallus napalensis*, Nagaland.

### INTRODUCTION

Mayo *et al.* (1997) reported that the genus *Amorphophallus* Blume is a palaeotropic aroid and occurs in Africa, Madagascar, India, South East Asia, Malaysia and North East Australia. According to Van der Ham *et al.* (2005) the genus comprises of about 200 species. However, *A. napalensis* (Wall.) Bogner & Mayo has been reported from Bhutan, Nepal and India and belongs to section Candarum. The members of section Candarum are characterized with spathe which is convolute below, usually oblong or oblong-ovate or ovate-lanceolate. Spadix shorter than spathe, appendix thicker than the inflorescence. Styles are 2 to 4 times longer than ovary. In India it is found in Darjeeling (W.B.), Sikkim, North Cachar, Mikir hills of Assam, Khasi and Jaintia hills of Meghalaya, Nagaland and Arunachal Pradesh. There are very few record of visitors cum pollinators for Indian *Amorphophallus*. Recently, Punekar and Kumaran (2010) have reported pollen morphology and pollination ecology of eight taxa of *Amorphophallus*, viz., *A. bulbifer* Roxb., *A. commutatus* Schott var. *commutatus*, *A. commutatus* var. *anmodensis* Sivad. et Jaleele, *A. commutatus* var. *wayanadensis* Sivad. et Jaleel. *A. commutatus* var. nov. (ined) *A. konkanensis* Hett. S.R. Yadav et K.S. Patil, *A. paeoniifolius* Dennst., and *A. sylvaticus* (Roxb.) Kunth from North Western Ghats (NWGS) and Konkan region of India. These authors have reported that out of eight taxa studied only two taxa, viz., *A. commutatus* var. *commutatus* and *A. commutatus* var. *wayanadensis*, are pollinated by *Trigona* bees, whereas, *A. konkanensis* and *A. sylvaticus* are pollinated by *Epuraea* (*Haptoncurina*) sp. (Nitidulidae) beetles only. According to

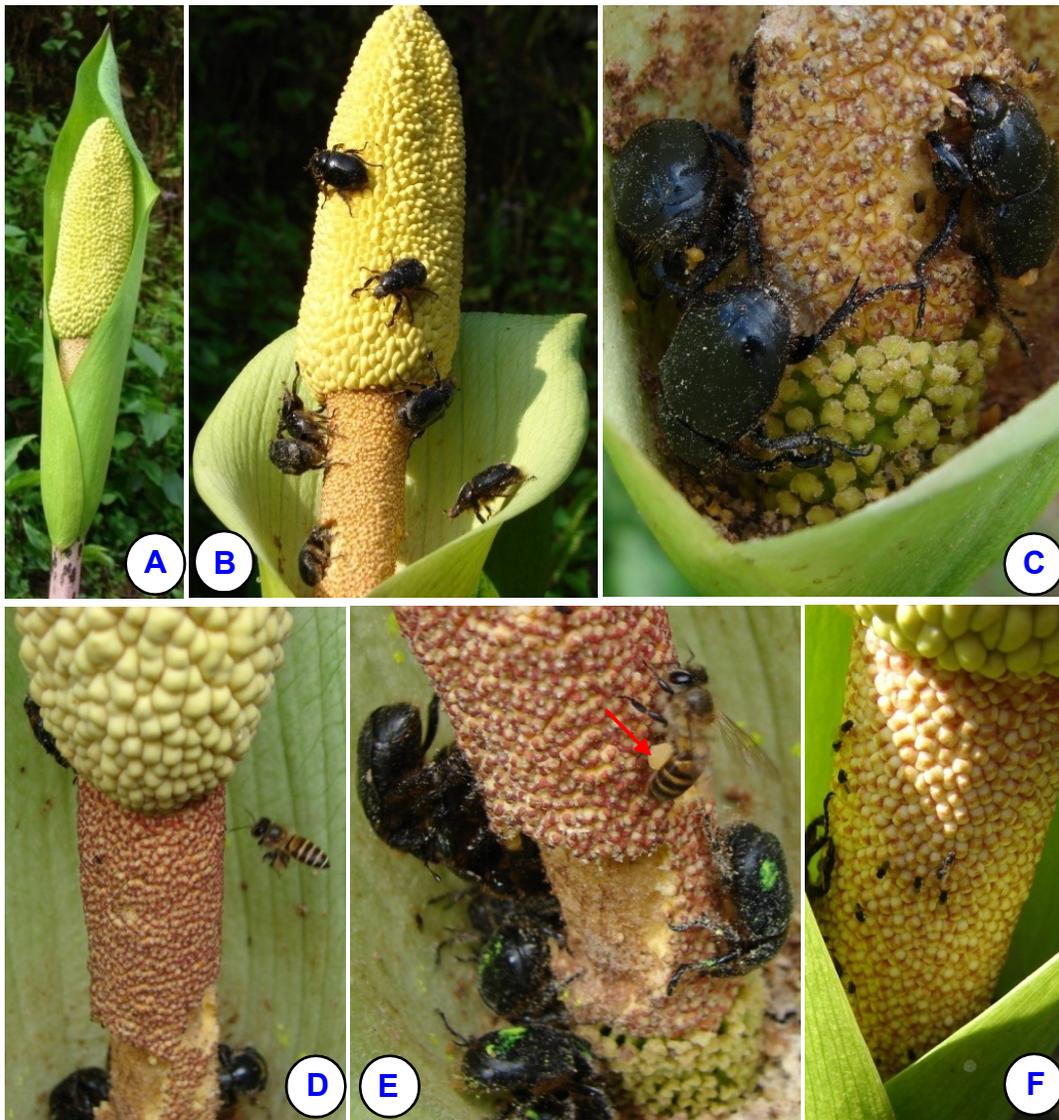
them, most of the taxa exhibit beetle pollination (Cantherophily). In addition to the beetles belonging to Bostrichidae (Horned powder post beetles), Cetoniidae (Black beetles), Cantharidae (Soldier beetles; *Rhagonycha* sp.) Hybosoridae (Black beetles), Lyctidae (*Lyctus* sp.), Nitidulidae (*Epuraea (Haptoncurina)* sp.), Rutelinae (Root grubs), Scarabaeidae (*Onthophagus* sp. and *Heliocopris* sp.) and Staphylinidae (Rove beetles), the flies belonging to Drosophilidae, *Drosophila* sp., Muscidae, *Musca domestica* and members of Calliphoridae (Blow flies), bees *Trigona* (Apidae), ants belonging to Formicidae, *Oecophylla smaragdina* and Dolichoderinae, *Tapinoma* sp. and Cockroach belonging to Blaberidae and Panesthiinae. Beath (1996), Sivadasan and Sabu (1989) have also reported carrion beetles *Haptoncurina motschulshii* and *Phaeochrous ampulus* as pollinators of *Amorphophallus hohenackeri* and *A. johnsonii* respectively. Beath (1996) has reported carrion beetles (*Phaeochrous ampulus*) as pollinators of *A. johnsonii* and Van der Pijl (1937) has studied biology and physiology of the genus *Amorphophallus*. However, Kite and Hetterscheid (1997) and Kite *et al.* (1998) have reported the presence of carrion beetle *Diamesus osculans* and scarab beetle, *Ardoretus* sp. in the spathes of *Amorphophallus titanium* and *A. paeoniifolius*. According to these authors the beetles are attracted towards these *Amorphophallus* taxa due to the production of dimethyl oligosulphides. However, in the present studies on the visitors and pollinators of *Amorphophallus napalensis*, at Lumami village of Zunheboto district and Arkong ward of Mokokchung district, Nagaland (North-east India) the beetles of genus *Parastasia* (Scarabaeidae), honey bee (*Apis indica*) of Apidae, stingless bee *Trigona* sp. (Apidae) and fruit flies of genus *Drosophila* (Drosophilidae) have been reported on the inflorescences of *A. napalensis*, for the first time.

## MATERIALS AND METHODS

The survey for the presence of insect visitors/ pollinators of *Amorphophallus napalensis* has been conducted at the natural localities of its occurrence at Lumami village, Zunheboto, at 880m amsl and in cultivation at Plot no. 227, Arkong ward of Mokokchung, Nagaland (North-east India) at 1350m amsl. The studies were conducted for eight years i.e. from 2008 to 2016 from 7.00 AM to 5.30 PM. at both the localities. Insect visitors were collected and got authentically identified by the entomologists of IARI, Pusa, New Delhi as well as based on our own collections. Field photographs were taken by using Canon digital Camera, model no EOS 550 D.

## OBSERVATIONS

The spathe of *A. napalensis* open during dusk and beetles are the only night visitors/ foragers which are attracted towards the spadix through its characteristic odour. No other visitors were observed at night. But, next morning other visitors were seen foraging for the pollen grains. The inflorescence emits nauseating gaseous odour similar to liquid petroleum gas. Due to the emission of odor at the first place beetles of genus *Parastasia* (Scarabaeidae), are attracted towards the spathe (Figures A & B). At this time no other visitors were seen over the inflorescence at both the localities. Next morning and during day these beetles were seen at the base of the spadix which is involute and covered by the spathe. During day flies of genus *Drosophila* sp. have also been observed over the male flowers. During this time honey bees (*Apis indica*) and stingless bees *Trigona* sp. were absent. At around 5.30 PM the beetles start flying away from the spathe and perch over other freshly opened spathe which were then producing strong odour. Visits of these beetles were monitored by putting a fiber-colour on their abdomen (Figure E) and it was observed that they can fly upto 15 meters distance at a stretch in the wild localities where the population of these inflorescences is more but they do not leave the spathe on second



**Figures A – F.** *Amorphophallus napalensis*, Inflorescence and visitor insects: **A.** An inflorescence freshly opened; **B.** Beetles of genus *Parastasia* crawling over the inflorescence; **C.** *Parastasia* sp. loaded with pollens visiting female flowers; **D.** Honey bee, *Apis indica* approaching the male flowers; **E.** *Apis indica* collecting pollen grains (red arrow showing pollen basket full of pollens) and the scars of beetle bitten male flowers; **F.** Fruit flies, *Drosophila* sp. visiting male flowers.

day in the cultivated locality where only one spathe was present. These beetles were seen devouring male flowers as well as the axis of the inflorescence and while doing so they got loaded with pollen grains on their body (Figures B – D). On the third day, the honey bees and stingless bees were seen to collect pollen grains from the inflorescences (Figures D & E) but they were not seen to go to the base of the spadix, whereas, the *Parastasia* beetles were always found hiding at the base and touching the stigmas of the female flowers. Hence, the main pollinators of *A. napalensis* at Lumami village are beetles

(*Parastasia* sp.). The inflorescences at wild localities showed fruit and seed set, whereas, in cultivation at Mokokchung, where only one inflorescence was present, the fruit and seed set did not take place.

## DISCUSSION AND CONCLUSION

The opened spadixes (inflorescence) of *Amorphophallus napalensis* emit an odour like liquid petroleum gas during dusk and attract females of *Parastasia* sp. beetles (Scarabaeidae). The odour producing chemical compound has been identified by Kite and Hettterscheid (1997) and Kite *et al.* (1998) as dimethyl oligosulphide. These beetles have been seen visiting whole inflorescence i.e. male flowers, female flowers as well as appendix (apical sterile portion of the spadix). These beetles devour male flowers and pollen grains during night and during day mostly hide at the base of spadix which is covered by the spathe. Therefore, these beetles have been identified as pollinators of *A. napalensis*. However, the beetle genera reported by Puneekar and Kumaran (2010) from NWGS and Konkan region as pollinators of other species of genus *Amorphophallus* have not been found on *A. napalensis* at Lumami and at Mokokchung. It has been noted that the wild populations growing at the elevation of 880 m in Lumami are pollinated by the same beetles i.e. *Parastasia* sp. as that of the population present in cultivation at the elevation of 1350 m at Mokokchung. Other visitors like honey bees, *Apis indica* and *Trigona* sp., visit flowers only for foraging pollens. The flies of *Drosophila* sp. were found to crawl over the male flowers as well as on the appendix of the spadix and never found visiting female flowers. Thus, as suggested by Puneekar and Kumaran (2010) these visitors are visiting inflorescences for nutrition only as they were seen collecting pollen grains (in the case of bees) and devouring pollen, anthers as well as axis of the spadix (in the case of beetles). However, the beetles of *Epuraea* (*Haptoncurina*) sp. (Nitidulidae), which are reported by Puneekar and Kumaran as the main pollinators of the species belonging to the section *Rhaphiophallus*, where the male and female flowers are separated by the neuter flowers, have not been found on the spadixes of *A. napalensis* at neither of the investigated localities. During the present studies, *Apis indica* has been reported as visitor for the first time on *A. napalensis*. The other visitors, viz., *Trigona* sp. and *Drosophila* sp. reported by Puneekar and Kumaran from the NWGS and Konkan do not help in pollination and they visit spadixes for alimentary resources (Puneekar & Kumaran 2010). These authors reported *Trigona* sp. as pollinators of various species of *Amorphophallus* at NWGS and Konkan, whereas, at Lumami, and Mokokchung district of Nagaland, the *Trigona* sp. has not been found to act as pollinator.

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## LITERATURE CITED

- Beath, D.N. 1996. Pollination of *Amorphophallus johnsonii* (Araceae) by carrion beetles (*Phaeocrous amplus*) in a Ghananian rainforest. *J. Trop. Ecol.* 12: 409 – 418.
- Kite, G.C. & Hettterscheid, W.L.A. 1997. Inflorescence odours of *Amorphophallus* and *Pseudodracontium* (Araceae). *Phytochemistry* 46: 71 – 75.
- Kite, G.C.; Hettterscheid, W.L.A.; Lewis, M.J.; Boyce, P.C.; Ollerton, J.; Cocklin, E.; Diaz, A. & Simmonds, M.S.J. 1998. Inflorescence odours and pollinators of *Arum* and *Amorphophallus* (Araceae). In: Owens, S.J. & Rudall, P.J. (Eds.), *Reproductive Biology*. Royal Botanical Gardens, Kew. Pp. 295 – 315.

- Mayo, S.J.; Bogner, J. & Boyce, P.C. 1997. *The genera of Araceae*. Royal Botanic Gardens, Kew.
- Punekar, S.A. & Kumaran, K.P.N. 2010. Pollen morphology and pollination ecology of *Amorphophallus* species from North Western Ghats and Konkan regions of India. *Flora* 205: 326 – 336.
- Sivadasan, M. & Sabu, T. 1989. Beetle pollination, cantharophily in *Amorphophallus hohenackeri* (Araceae). *Aroideana* 12: 32 – 37.
- Van der Ham, R.W.J.M.; Grob, G.B.J.; Hettterscheid, W.L.A.; Star, W. & Van Heuven, B.J. 2005. Notes on the genus *Amorphophallus* (Araceae) -13. Evolution of pollen ornamentation and ultrastructure in *Amorphophallus* and *Pseudodracontium*. *Grana* 44: 252 – 265.
- Van Der Pijl, L. 1937. Biology and physiological observations on the inflorescence of *Amorphophallus*. *Rec. Trav. Bot. Neerl.* 34: 157 – 167.