

Short Communication

## Biology of rock bulrush (*Schoenoplectus juncooides*) in the wet land rice fields of south Kerala

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### Abstract

Biology of rock bulrush (*Schoenoplectus juncooides* (Roxb.) Palla), an emerging sedge weed in the lowland rice fields of south Kerala was studied during *rabi* 2017-2018. It was observed to grow as an annual in cultivated lowlands but exhibited perennial nature in undisturbed fields. The weed completed its life cycle through five phenological stages *viz.*, germination, seedling, flowering, spike development and seed maturity. Prolific seed production (528–1120 seeds/plant) and sprouting of vegetative buds from rhizomes make rock bulrush a persistent weed.

**Keywords:** Biology, Phenology, Rock bulrush, Sedge weed.

Yield reduction due to weed infestation is more challenging in wet seeded rice due to the co-emergence of rice and weed seedlings. Rock bulrush or hard stem bulrush (*Schoenoplectus juncooides* (Roxb.) Palla) locally known as ‘*Mattipullu*’ or ‘*Manapullu*’, belonging to the family Cyperaceae is an emerging sedge weed in the wetland rice fields of southern Kerala. It is also known as *Scirpus juncooides* Roxburgh or *Scirpus rockii* Kukenth. Rock bulrush is one among the twelve most troublesome weeds having cosmopolitan distribution in the south and south East Asian rice fields (IRRI, 2017).

Rock bulrush (*Schoenoplectus juncooides* (Roxb.) Palla) of family Cyperaceae has been documented to occur globally in direct seeded lowland rice. It has now invaded rice fields of south Kerala in India and has become a problematic sedge weed. Sasidharan (2017) reported the occurrence of *S. juncooides* across Kottayam, Alappuzha, Kollam, Idukki, Pathanamthitta, Thiruvananthapuram, Malappuram and Kozhikode districts of Kerala state. Aggressive growth habit of the weed makes

it a potent competitor for rice (Mukherjee et al., 2008). In this background, the present study was undertaken to understand the biology of the weed, which can help in formulating effective management strategies.

The study was conducted during the *rabi* season (November 2017 to March 2018) in the lowland rice field of Nemom block of Thiruvananthapuram, Kerala. The experimental field was located at 8° 25' 49" N latitude and 76° 39' 04" E longitude at an altitude of 29 m above the mean sea level. Average temperature, relative humidity and total rainfall received during the period were 27.6°C, 80 per cent and 76 mm respectively. Soil of the experimental field was strongly acidic (pH 5.4) with normal electrical conductivity (0.47 dS/m). The soil was low in available nitrogen (275.97 kg/ha), high in available phosphorus (39.20 kg/ha) and available potassium (240 kg/ha) and medium in organic carbon (1.10%). The field had been under rice crop for the past many years. Land was thoroughly prepared by puddling followed by leveling. Weeds and stubbles of the previous crop were incorporated

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by wet tillage. Weed flora consisted of grasses, sedges and broad leaved weeds. *Schoenoplectus juncooides* was observed as the dominant weed flora in the study area. The biology of the weed was studied by observing randomly selected sample plants from 20 m<sup>2</sup> area earmarked in the experimental field right from their emergence.

Weed biology refers to the study of weeds in relation to its habit, habitat, propagation and stages of growth. The weed was observed to be an annual in cultivated fields with an average duration of 106 days in wet seeded rice. However, it had the potential to grow perennially through rhizomes as observed in fields that were left undisturbed. Khalid and Siddiqui (2014) also described rock bulrush as annual tufted sedge in the cultivated rice fields with a perennial habit in unattended wetlands. *Schoenoplectus juncooides* was found to co-exist with rice crop and also occupied the field bunds and water channels. Apart from rice fields, it is also reported to inhabit marshes, ditches, pond banks, river banks and waterlogged areas (Pal and Choudhury, 2014). Donayre et al. (2016) also reported copious growth of this sedge in irrigated and rainfed lowland rice fields of Philippines.

Rock bulrush was observed to grow through five phenological stages to complete its life cycle. These stages included germination, seedling, flowering, spike development and seed maturity (Plate 1). Seed germination commenced in 3 to 7 days of wet seeding of rice; flowering in 22 days, spike development in 33 days and seed maturity in 68 days (Table 1). The weed exhibited lodging one week after attaining spike maturity which coincided with 40<sup>th</sup> day of growth. Even after seed maturity, the plants were green for more than one month followed by drying of the aerial portion. Short time period for attaining reproductive stage, prolific seed production and fast seed maturity favoured season long infestation of rock bulrush in the field. Aggressive growth of the weed throughout the rice crop's lifecycle was noticed by Mukherjee et al. (2008).

#### *Vegetative characteristics of rock bulrush*

*Schoenoplectus juncooides* is an erect, tillering sedge with round stem that grows up to a height ranging from 64.70 cm to 70.20 cm at maturity. According to NPPC (2017) height of rock bulrush ranged from 15 to 70 cm with scaly, light brown coloured leaf sheaths. Unlike other sedges, shoot of rock bulrush

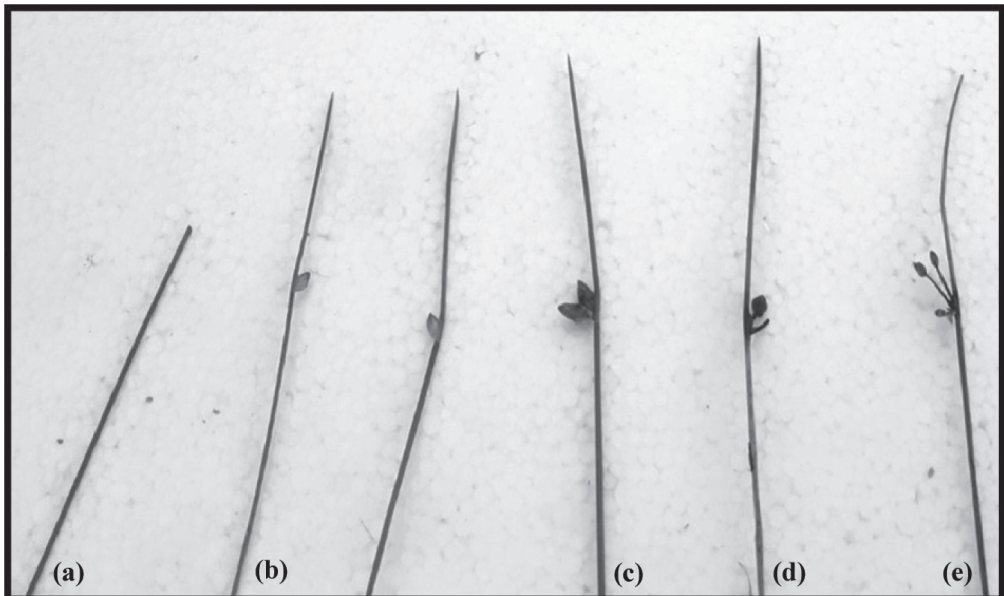


Plate 1. Stages of rock bulrush: (a) seedling (b) flowering (c) spike development (d) seed maturity and (e) drying

**Table 1.** Biology of rock bulrush

Characteristics	Min.	Max.	Mean	SEm(±)
<b>a. Phenology</b>				
Days to germination	3.00	7.00	5.30	0.40
Days to flowering	20.00	24.00	22.30	0.52
Days to spike maturity	30.00	35.00	33.00	0.52
Days to lodging	39.00	42.00	40.30	0.37
Days to seed maturity	66.00	70.00	67.80	0.51
Duration	90.00	120.00	106.10	3.22
<b>b. Shoot characteristics</b>				
Plant height at seedling (cm)	1.50	2.30	1.94	0.09
Plant height at flowering (cm)	42.00	48.20	45.21	0.73
Plant height at maturity (cm)	64.70	70.20	66.76	0.62
Number of leaves plant <sup>-1</sup>	14.00	28.00	19.60	1.29
Shoot dry weight (g plant <sup>-1</sup> )	1.11	3.31	1.82	0.23
Dry matter plant <sup>-1</sup> (g)	1.56	5.98	2.81	0.42
Biomass production (t ha <sup>-1</sup> )	0.83	1.08	0.96	0.07
<b>c. Root characteristics</b>				
Depth of rooting (cm)	15.00	19.90	17.76	0.60
Root dry weight (g plant <sup>-1</sup> )	0.40	2.90	0.99	0.22
Rhizome dry weight (g plant <sup>-1</sup> )	0.02	0.04	0.03	0.002
Root: shoot ratio (length)	0.21	0.30	0.27	0.01
Root: shoot (dry weight)	0.36	0.88	0.52	0.05
<b>d. Floral characteristics</b>				
No of tillers with spike plant <sup>-1</sup>	6.00	16.00	12.40	1.02
No of spikes tiller <sup>-1</sup>	2.00	4.00	2.80	0.25
No of spikes plant <sup>-1</sup>	24.00	48.00	33.20	2.68
Length of spike (cm)	1.00	1.60	1.24	0.06
Spike diameter (cm)	1.40	1.70	1.56	0.04
<b>e. Seed characteristics</b>				
No of seeds spike <sup>-1</sup>	17.00	23.00	19.90	0.61
No of seeds plant <sup>-1</sup>	528.00	1120.00	861.60	56.30

is hollow and circular in cross section and appears to be a pseudostem formed by the leaf and leaf sheath. Eickhoff (2009) also observed round, cylindrical stems for rock bulrush with lodging of heavy seed bearing culms. Vigorous tillering of the sedge was observed in the paddy field, with an average tiller production of 20 tillers/ plant. The shoot dry weight ranged from 1.11 g to 3.31 g with dry matter production of 1.56 to 5.98 g/plant (Table 1). Biomass production of the weed varied from 0.83 to 1.08 t/ha in the weedy check plots.

Roots of rock bulrush are fibrous and the underground rhizomes develop around 100-105 days after germination. The depth of rooting ranged from 15 cm to 20 cm with root dry weight of 0.40 to 2.90 g/ plant. Deep, fibrous roots of the weed denoted the significance of deep ploughing for

effective management. Small rhizomes had dry weight of 0.02 to 0.04 g/plant. Similar observations on rock bulrush producing shorter rhizomes were made by Le Bourgeois et al. (2008). Root length: shoot length ratio was 0.27 (Table 1) and root dry weight 34% of the total dry matter of plant.

### Seed production

Inflorescence of rock bulrush is botanically a spike which is sessile and laterally positioned (Plate 2).

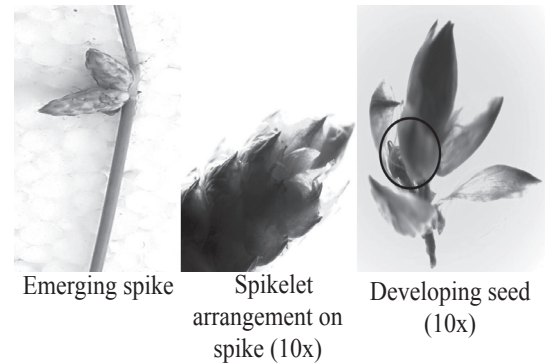


Plate 2. Floral characteristics of rock bulrush

Number of spikes in individual tiller varied from 2 to 4 with a mean length of 1.24 cm and mean diameter of 1.56 cm. Khalid and Siddiqui (2014) reported that *Schoenoplectus juncooides* could produce 1-3 sessile green spikes /culm. Number of spike bearing tillers in a plant varied from 6 to 16 (Table 1). On an average, 33 spikes were produced by a single plant (Table 1). Seeds of *Schoenoplectus juncooides* resembled amaranth seeds with an initial cream colour, turning brown to black upon maturity with a mean seed length of 0.58 mm, width of 0.45 mm and thousand seed weight of 1.5 g (Plate 3).

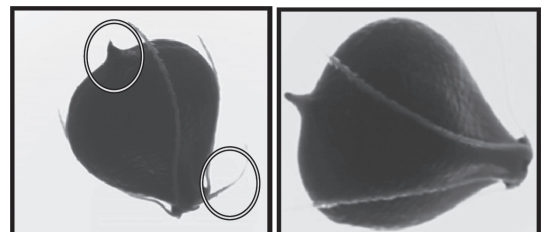


Plate 3. Seed characteristics of rock bulrush



Plate 4. Propagules of rock bulrush A. Seeds B. Vegetative buds C. Rhizomes

The seeds had a spiny apex with 4 to 6 bristles. As the seeds mature, they start shedding from the spike along with the glumes attached to it. Lodging of culms and spiny tip of seeds help easy dispersal of rock bulrush seeds through water, clothes and implements (Plate 4). Seed surface is rough with bristles, helping in dispersal by sticking on to rice grains, straw, chaff, etc. Caton et al. (2010) reported the potential of rock bulrush as a seed contaminant in rice. Sprouting of vegetative buds occurred simultaneously with drying of spikes and seed dispersal. Complete drying of the weed occurred from 90<sup>th</sup> to 120<sup>th</sup> day with a mean duration of 106 days for completing the life cycle.

#### Propagation

*Schoenoplectus juncooides* is propagated largely by sexual reproduction through seeds. Maximum seed production capacity of rock bulrush was estimated to be 20/spike and 1120/plant. IRRI (2017) reported the seed production capacity of rock bulrush as 1500 seeds /plant. In the field, seed germination of rock bulrush commenced within 3 to 7 days of wet seeding of rice leading to severe competition for nutrients, space, solar radiation and water at early stages of crop growth. Chiang (1983) observed significant influence of season in deciding the emergence time of *Schoenoplectus juncooides* and reported faster emergence during *rabi* season (2 days) compared to *kharif* (5 days). Hamamura (2002) explained the role of perianth lobe in water imbibition for germination.

However, fresh seeds collected after physiological maturity failed to germinate under laboratory conditions. This could be attributed to seed dormancy exhibited by the weed. Development of seed dormancy after 20 to 25 days of flowering was observed by Ishikura and Soga (1978). Under field conditions, those seeds which germinated might be from the seed bank reserve deposited by earlier weed flush which must have overcome dormancy with variations in temperature levels. High temperature and wide daily temperature fluctuations can break dormancy in many species (Pons and Schroder, 1986).

Watanabe et al. (1991) opined that the seed viability of *Schoenoplectus juncooides* may extend beyond a decade, making it difficult to eradicate the soil weed seed bank. Sprouting of vegetative buds from the underground rhizomes was observed throughout the crop duration of rice. Adoption of integrated management strategies that focus on depletion of underground rhizomes and weed seed bank can help in achieving long term control of the weed.

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