biaceae, the sexes are not aggregated. This gets support from the lack of segregation along an environmental gradient in all these five taxa[9] (Raju, unpublished data) from the same habitats.

To summarize: (i) the sex ratios in dioecious Euphorbiaceae seem to be male-biased, as is the case with most other dioecious perennial tropical angiosperms; (ii) anthropogenic factors can alter the sex ratios (by causing ecological imbalance and/or affecting their breeding systems), and (iii) the absence of significant interpopulation variation suggests that the dispersion of male and female sexes in the taxa studied are independent of crowding and, probably, habitat differences.

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EFFECT OF VESICULAR-ARBUSCULAR MYCORRHIZA ON UPTAKE OF PHOSPHORUS AND ZINC IN RICE (*ORYZA SATIVA* L.)

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INCREASED rice production requires heavy doses of fertilizer, both chemical and biological. As rice is grown under standing water for several weeks it was not considered practical to search for vesicular-arbuscular mycorrhizal (VAM) fungi, since they require aerobic conditions for proliferation. However, Ammani *et al*[1] reported colonization of rice roots by VAM. Gangopadhyay and Das[2] observed the association of Endogone type mycorrhizae with upland rice cultivars and increase in both P uptake and yield in mycorrhizal-inoculated plants. However, they did not investigate its effect on Zn uptake. Since Zn deficiency is fairly widespread in the Tarai belt of UP, it was of interest to examine the efficiency of VAM fungi in the uptake of P and Zn in rice under glasshouse conditions.

Glomus caledonius (Nicol. & Gerd.) was maintained on maize grown in sterile sand supplied with Hoagland's solution with half strength of phosphorus for a minimum period of 90 days. VAM inoculum (5 spores/g soil) was mixed initially in trays with P-deficient sterilized soil (pH, 6.5; organic matter, 1.63; available P, 11.2 ppm; Zn, 0.67 ppm) and seeds of rice (*Oryza sativa* L.) cultivars Jaya and Ratna were sown. Spore washings of *G. caledonius* mixed in another tray served as control. Twentyone-day-old seedlings were transplanted in pots (4 plants/2 kg/pot) filled with the same soil as that in trays. Prior to transplantation of rice seedlings, two holes were made in each pot and filled with VAM inoculum of 200 spores. Watering was done daily to maintain the natural condition for rice. Each treatment was replicated five times.

After 45 days of transplanting, plants were harvested for recording shoot and root dry weights. Phosphorus and zinc contents in root and shoot were estimated after oven-drying[3] the samples and atomic absorption spectrophotometry respectively. To determine the rate of infection, roots were stained[4] and per cent colonization was calculated[5].

VAM significantly increased shoot and root dry weight as also the level of phosphorus and zinc in both the cultivars of rice tested (table 1). The increased dry weight might be a result of enhanced level of nutrients by mycorrhizal inoculation[6-8] as VAM improves phosphorus level in plants[9,10] and increased uptake of Zn may be a side effect of improved P nutrition[11,12]. Shoots and roots of mycorrhizal plant in both the cultivars of rice exhibited approximately 2 and 3 times higher Zn level than in non-mycorrhizal control plants (table 1). It indicated that VAM infection can increase P uptake and relieve the Zn deficiency. Hence VAM inoculation looks promising for management of the Khaira disease of rice caused by Zn deficiency.

Table 1 *Effect of mycorrhizal infection on shoot and root weight and P and Zn content of rice cultivars Jaya and Ratna*

Cultivar	Mycorrhizal infection (%)	Shoot dry weight (g)	Root dry weight (%)	P content (%)		Zn content ($\mu g\ g^{-1}$)	
				Shoot	Root	Shoot	Root
Jaya(+M)	40	4 4^b	3 1^b	0 215^b	0.156^b	91 4^b	71 6^b
Jaya(−M)	0	2.4^a	1 4^a	0.132^a	0 070^a	42.3^a	24 5^a
Ratna(+M)	49	4 8^b	3.2^b	0 291^c	0.197^c	110 3^c	80 8^c
Ratna(−M)	0	2.6^a	1 6^a	0.142^a	0.082^a	45 9^a	28 7^a

(+M) = Mycorrhizal, (−M) = Non mycorrhizal; Mean values in a vertical column without common letters in their superscripts are significantly different at $P = 0\ 05$

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TISSUE INVERTASE AS A POSSIBLE INDEX OF SMUT INFECTION IN SUGARCANE

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CHANGES in the activity of invertase in host-pathogen relationships involving biotrophic fungi are well-recognised[1,2]. In sugarcane infected by the smut pathogen, symptom expression occurs only after an incubation of 40 to 60 days. An early detection of infection by any physiological index would enable early diagnosis of the disease for various purposes. Hence, the changes in invertase activity of sugarcane settlings in the early stage of smut development were examined.

Healthy and smut-infected single bud cuttings of the susceptible cane Co 1287 were separately

Table 1 *Tissue invertase activity of healthy and smut-infected sugarcane settlings*

Tissue	Invertase activity* (μ g reducing sugar/hg of dry tissue)	Per cent increase over healthy tissue
Healthy leaf	2893	–
Healthy apical meristem	3735	–
Diseased leaf	4260	47.3
Diseased apical meristem	6292	68.5

*Mean of four replicates.