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MEIOTIC SYSTEM OF *EMEX AUSTRALIS* - A PROLIFIC WINTER ANNUAL WEED

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ABSTRACT

Emex australis Steinh. is a prolific winter annual which has assumed the status of an obnoxious weed. It grows in wide range of climatic conditions and has a potential to spread to even more diverse habitats. The meiotic system of the plant is studied to ascertain the ability to spread. It was found that the vigor to adapt to different habitats is provided both by its breeding and meiotic systems, though the former contributes more to generation of variation. In meiotic system, moderate chromosome number provides for shuffling through independent assortment while small chromosome size and low recombination index have minor role to play.

KEYWORDS: ***Emex australis*, meiotic system, breeding system, recombination index, chromosome number, chromosome size.**

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INTRODUCTION

Aggressiveness in weeds is largely conferred by the amount of genetic variation present in them; and by the ability of plants to adapt to the disturbed and/or changing environmental conditions with great ease. This ability stems from genotype-environment interaction. More variable the genotype of a plant more likely is its tendency to be plastic. Genetic variation, in nature, is contributed by the plants' breeding and meiotic systems. *Emex australis*, a native of South Africa[1], is an aggressive annual herb capable of growing in a wide range of climatic conditions from high to low rainfall regions[2]. Belonging to family Polygonaceae, it is found in highly disturbed sites like roads, tracks, firebreaks, picnic sites, old homesteads and watering points, edges of creeks, riverine flats and granite rocks[2, 3]. An herbaceous winter annual growing extensively in and around Jammu city[4], the species has a potential to spread. The plants also form semi-continuous populations in the University Campus (University of Jammu, J&K, India) from December to May.

Plants are highly variable in several morphological parameters. They can be as small as 21.4 cm and as extensive as 76.1 cm. Equally variable in vigor, the plants of all sizes are quite sturdy. To characterize genetic diversity in this weed, worked out the breeding and meiotic systems of the species in an endeavor to quantify the extent of variation generated by each component.

In the present communication, the cytological details of the plant were worked out to see if there is any role of meiotic system in generating variation in the plant and thereby, conferring on it the ability to adapt to wide range of habitats.

MATERIAL AND METHODS

Plant body of *E. australis* is initially a rosette of leaves, which later on differentiates shoots at the base. Shoots are prostrate, dichotomously branched and grow indeterminately till their ends start turning brown. Being monoecious, flowers are unisexual and borne in the axils of shoots as well as at the base. Male flowers are borne in a raceme while female are solitary. Both the flowers are small, herbaceous, actinomorphic and devoid of nectar and odor.

Karyotype preparations were made from root tip cells. For this purpose, root tips approximately 1 cm in length were excised from young seedlings, washed carefully under tap water and pretreated with 0.002M 8-hydroxyquinone for 4½ hr at 4^0C. The tips were fixed in propiono-alcohol for 24 hr at 4^0C, stained in Feulgen and subsequently squashed in 0.5% propiono-carmine. For studying pollen mother cell (pmc) meiosis, young male buds were fixed in a mixture of chloroform, absolute alcohol and propionic acid (4:3:1) for 24 hr at 4^0C and squashed in 0.5% propiono-carmine. The slides were photomicrographed using Nikon $FM3_A$ Camera.

RESULTS AND DISCUSSION

All good root tip metaphase spreads have 2n=20 (Fig 2). An aneuploid with 2n=21 was also found but unfortunately its pmc meiosis could not be worked out (Fig 3). The total chromatin length (TCL) varies between 138.61 μm and 168.67 μm. The pmc meiosis is regular and ten perfect bivalents are formed at prophase I and metaphase I. The chiasmata frequency at diakinesis and metaphase-I averages 14.3 and 11.5 per cell respectively. The corresponding RI works at 24.3 and 21.5. Chromosome segregation is normal with 10 chromosomes at each pole. The second division is also regular and pollen viability averages 86.13%.

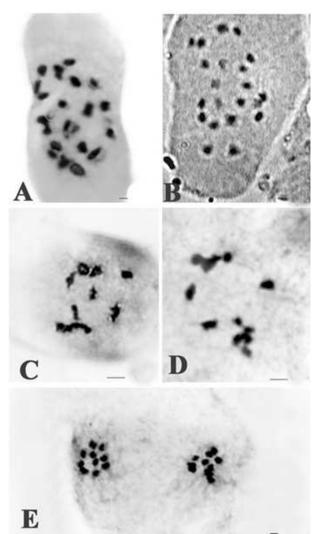
The components of meiotic system relevant for generating variation are chromosome number, chromosome size and frequency of crossing over[5, 6, 7]. Exceptions apart, high chromosome number, long chromosome size and higher frequency of crossing over promote recombination index

(RI), the first through independent assortment and the latter two by reshuffling the genes comprising a linkage group. However, in *E. australis,* small chromosome size and subsequently low chiasmata frequency (~1 chiasma per bivalent) do not provide the possibility of generating greater variation through meiotic system. The chiasmata frequency could not be calculated at diplotene and is likely to be an underestimate. But presence of moderate chromosome number (2n=20) increases the chances of generating variability through independent assortment. In *Plantago patagonica*, a strictly self-pollinated species, higher chromosome number (2n=20) and higher RI (30.1) provide for generation of variability through meiotic system[8]. This is in contrast to *P. lanceolata* with 2n=12 and RI=18.8 wherein variability generated through breeding system is preponderant because of its self-incompatible nature and hence obligate outcrosser. *P. drummondii* with a predominantly self-pollinated system has 12 chromosomes and 23.2 RI[8]; a situation more or less akin to that in *E. australis*. The chromosome number as well as RI of *E. australis* is slightly higher than that in *P. drummondii*. All the features are indicative of chromosome and breeding systems being the sources of variation. In *Commelina benghalensis,* also, moderate chromosome number (2n=22) and chiasmata frequency do not provide for generation of much genetic variability. However the species is a colonizer and achieves this success through variation in breeding system[9, 10]. Similarly variability in *E. australis* is not largely on account of its meiotic system. Bulk of this variation can be attributed to facultatively xenogamous breeding system[11]. Coupled with an efficient reproductive output, prolonged seed dormancy[12] and retention of seed viability thereof, the species is equipped with the potential to spread and be aggressive[11].

EXPLANATION TO FIGURE

FIGURE

Root tip chromosomes and pmc meiosis of E. austrsalis : (A) Mitotic metaphase spread of plants of E. australis with 20 chromosomes, (B) An aneuploid with 21 chromosomes, (C) Pmc with 10 bivalents at diakinesis, (D) Pmc with 10 bivalents at metaphase-I, and (E) Pmc with normal (10:10) segregation at anaphase-I.



CONCLUSION

E. australis attains more variation and hence ability to adapt to different climatic conditions through its breeding system rather than its meiotic system. Isolation of an aneuploid is suggestive of numerical variation in the population which could prove that plants do generate variation through meiotic system. However, this needs to be worked out extensively at the population level.

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