the blood agar plates appears indicative of the fact that with the precipitating action on the haemoglobin is associated the activity of a haemolysin which spreads in the cultural medium. The failure to recognize by naked eye or low enlargement examination the process of haemolysis near the bacterial colonies is the consequence of the strong opacity of the precipitated haemoglobin within a large number of red cells.

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Ferns of Rajasthan – behaviour of chlorophyll and carotenoids in drought resistance

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Summary. The relationship of chlorophylls and carotenoids with drought resistance has been studied in some of the ferns found in Rajasthan, without heating as well as after heating the fronds at 60 °C. The xerophytic species showed lesser degradation of chlorophyll and exhibited higher carotenoid contents.

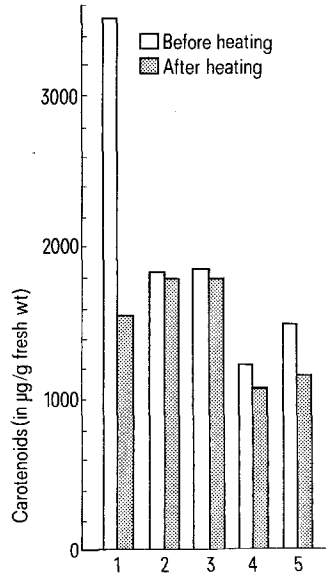
The importance of chlorophyll, proline and -SH compounds is well-known in the mechanism of drought resistance of Angiosperms[1], but their role in the lower vascular plants is yet to be studied. Pteridophytes generally grow in moist places but some of the forms also survive in comparatively drier conditions. So the study of the physiological processes involved in adaptations to such habitat proved interesting[2]. The present study furnishes information about the behaviour of chlorophyll in drought resistance of some of the ferns found growing in the arid and semi-arid regions of Rajasthan. It is also interesting to note that some of the ferns, e.g. *Actiniopteris radiata, Adiantum lunulatum,* etc, remain alive even during the months of May and June when the atmospheric temperature is very high, i.e. 44–48 °C, and relative humidity is very low: the ferns look very dry. However, with the first shower of rain these ferns become as green as fresh.

Materials and method. Fresh fern fronds were collected in the wild during the months of August and September from different places in Rajasthan e.g. Gorumghat, Mt. Abu, Sirohi and Jodhpur. Chlorophyll estimations were done by Robbelen's method[3], without heating, as well as after heating, the fronds at 60 °C (as suggested in the method by Murty and Majumdar[4]). 3 replicates were taken for each estimation.

Influence of 60 °C temperature for 2 h on chlorophyll *a*, chlorophyll *b* and total chlorophyll of some ferns collected from Rajasthan

Plants	Percentage degradation		
	Chlorophyll *a*	Chlorophyll *b*	Total chlorophyll
Actiniopteris radiata	0.00	0.00	0.50
Adiantum lunulatum	0.00	5.82	3.00
Adiantum incisum	2.14	1.60	2.00
Athyrium sp.	13.19	2.60	9.00
Cheilanthes albomarginata	4.07	0.00	2.00

Results and discussion. The degradation of chlorophyll *a*, chlorophyll *b* and total chlorophyll of various fern fronds as affected by heating are shown in the table, while the carotenoids are presented in the figure. The table indicates that in *Actiniopteris radiata* the degradation of total chlorophyll due to heating is comparatively lesser than in others ferns, which confirms the earlier work[5]. The sequence of degradation of total chlorophyll is as follows: *Actiniopteris radiata, Adiantum incisum, Cheilanthes albomarginata, Adiantum lunulatum* and *Athyrium* sp. This order of degradation is closely related to their power of drought resistance and regeneration[6]. It was also observed that the old, shrunken and almost dry leaves of *Actiniopteris radiata, Adiantum lunulatum* and *Cheilanthes albomarginata* become green and fresh just after the first shower of rain, sometimes during the months of June or July, which suggests that there is almost no degradation of chlorophyll in these plants during the scorching heat of the summer months. The present study confirms it.



Effect of 60 °C temperature for 2 h on carotenoids of some ferns collected from Rajasthan (1 *Actiniopteris radiata*, 2 *Adiantum lunulatum*, 3 *A. incisum*, 4 *Athyrium* sp., 5 *Cheilanthes albomarginata*).

As is evident from the table, in the degradation of chlorophyll *a* and chlorophyll *b* there is little change in the samples of heated as well as unheated ones of *Actiniopteris radiata* and *Adiantum lunulatum*. For other ferns, the order of increasing degradation is *Adiantum incisum, Cheilanthes albomarginata* and *Athyrium* sp.

The results of carotenoid contents in the heated and unheated samples are represented in the figure. It is interesting to note that the carotenoid contents are maximum in *Actiniopteris radiata,* which is a very resistant type. At the same time, this species shows maximum degradation of carotenoids, i.e. more than 50%. *Cheilanthes albomarginata* comes second while much less degradation has been noted in both the species of *Adiantum* studied for the present purpose. The functions of carotenoids in plants, although still far from clear, is also to protect the plants from photosensitized oxidation and chlorophyll degradation[7-10]. From the present study, it appears that the xerophytic species of ferns possess higher carotenoid contents and show lesser degradation of chlorophylls.

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Comparative effect of silver ion and gibberellic acid on the induction of male flowers on female *Cannabis* plants[1]

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Summary. Silver ion applied as $AgNO_3$ to the shoot tip of female plants of *Cannabis* induces male flowers. It is more effective than gibberellic acid (GA_3) in maintaining the induced state.

The silver ion (Ag^+) has recently been shown to be a potent inhibitor of ethylene action in ethylene-sensitive tissues[2]. In cucumber, higher ethylene levels are associated with femaleness[3,4] and Ag^+ induces maleness[5]. The present study was undertaken to test the effect of Ag^+ on the sex-expression in the dioecious *Cannabis sativa* L. and to compare its effect with gibberellic acid (GA_3). The preliminary findings are reported here. Earlier work on this plant had indicated that ethylene supplied as ethephon induces female flowers on male plants[6] and GA_3 application initiates male flowers in female plants[7].

Material and methods. Seedlings of *Cannabis sativa* L. were raised in earthen pots. The sexes were separated after the first few flowers had been formed. 10 female plants of uniform height, bearing 3 or 4 flowering nodes were selected for each treatment. The treated plants received either GA_3 or $AgNO_3$ dissolved in distilled water containing 0.02% Triton X-114 as the surfactant. Controls were given only distilled water and surfactant. The test compounds were applied to the shoot tip as a daily 10 µl drop for 10 days. The final amount of GA_3 or $AgNO_3$ received by each plant came to 100 µg. The test plants were maintained under natural conditions in the departmental garden. The number of plants showing conversion and the number of nodes bearing male flowers (including intersexual flowers) were recorded at 5-day intervals. Confidence inter-

Effect of GA_3 and $AgNO_3$ on the number of plants showing male flowers and the number of nodes per plant bearing male flowers in the female plants of *Cannabis sativa*

Treatment[a] (µg/plant)	Number of days after application															
	0		5		10		15		20		25		30		35	
	x̄	CI	x̄	CI	x̄	CI	x̄	CI	x̄	CI	x̄	CI	x̄	CI	x̄	CI
GA_3 (100)																
Number of plants showing male flowers	0		0		2		2		5		5		5		5	
Number of nodes bearing male flowers[b]	–		–		0.8	1.03[c]	1.1	1.4[c]	2.1	1.9[c]	2.6	2.3[c]	2.6	2.3[c]	2.6	2.3[c]
$AgNO_3$ (100)																
Number of plants showing male flowers	0		1		1		3		7		9		10		10	
Number of nodes bearing male flowers[b]	–		0.2	0.1[c,d]	0.2	0.1[c]	0.8	0.8[c]	2.8	2.2[c]	3.9	2.7[c]	4.6	2.9[c]	4.6	2.9[c]

[a] mean values of 10 plants; [b] nodes with at least 1 perfect male flower; ± confidence intervals (CI); [c] significantly different from controls at $p \leq 0.05$; [d] significantly different between treatments at $p < 0.05$.