determined following the method already described[5]. Three plants belonging to each family were used for isolation and 4–6 isolates from root and leaf pieces were obtained once. The nitrogen-fixing efficiency was expressed as mg N fixed. g^{-1} g malate added.

A. lipoferum is widespread among the weeds investigated and the cultures possessed appreciable nitrogen-fixing efficiency (Table I). Although *A. lipoferum* could be isolated from most of the weed plants considerable variations with regard to N_2-fixing ability was observed. Nitrogen fixation was higher in cultures isolated from the roots of *Pistia stratiotes*, *Marsilia quadrifolia*, *Boerhavia rapens* and *Euphorbia hircta*, while *Lucus aspera*, *Colocasia anticorum* and *Cyperus* sp. harboured *A. lipoferum* cultures with low nitrogen-fixing ability. The phyllosphere isolates were less efficient than the isolates from the roots of same plant in fixing nitrogen except for those from *Eclipta alba*, *Mardamia spirata* and *Colocasia anticorum*. Moreover, *A. lipoferum* was absent from the leaves of some plants, while present in the roots.

A. lipoferum has been isolated from the roots of several plant species, with wide variations in the N_2-fixing ability[2,4,6]. Variation in nitrogen fixation by *A. lipoferum* isolates from the roots of several rice cultivars has also been observed (Nayak and Rao, unpublished). This has been attributed to the differences in the root exudates and the intrinsic ability of the isolates for efficient utilization of the available carbon source. Also, Kavimandan *et al.*[3] observed wide variations in N_2-fixation by *A. lipoferum* depending on the wheat varieties.

Our studies indicate the widespread association of *A. lipoferum* with the roots of weeds in rice fields.

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CARBONIC ANHYDRASE ACTIVITY AS AN INDEX OF ZINC NUTRITION IN CABBAGE

ZINC nutrition has assumed considerable importance in Indian Agriculture as its widespread deficiency has been reported in a variety of crops. Among the various functions of zinc in plants, its association with carbonic anhydrase (CA) (EC 4·2·1·1) activity was one of the earliest to be detected. CA is a zinc containing enzyme occurring mostly in the chloroplast in plants. It catalyses the hydration of CO_2 reversibly and carries out CO_2 fixation according to Calvin cycle where ribulose diphosphate is carboxylated[4]. In recent years attempts have been made to relate the enzyme activity in plants with their zinc content and yield, and it has been suggested that the activity of the enzyme could be used as an index of zinc nutrition in crop plants[1,2,8]. However, there has been no study so far, on the activity of the enzyme in vegetable crops. An attempt was, therefore, made to study the relationship among CA activity, zinc content of the leaf and the yield of cabbage.

For this study samples were collected from zinc-treated plots of a micronutrient experiment on cabbage (Cv. Pride of India) conducted at the Indian Institute of Horticultural Research Experimental Farm, Hessaraghatta, Bangalore. The details are furnished in Table I. The experiment was conducted on red sandy loam soil (Typic Haplustalf) with low organic matter,

TABLE I

Effect of soil and foliar application of zinc on yield, leaf zinc and CA activity in cabbage
(Means of 3 replications data of two seasons)

Treatment	Yield kg/plot	Leaf Zn ppm	CA activity *
N, P, K only	7·367	23	13·8
N, P, K + zinc soil application(10 kg/ha)	11·280	260	24·8
N, P, K + Foliar** application of zinc	11·633	246	36·3
C.D. (5%)	3·325	64·7	7·3

* CO_2 evolved/mg protein/hour at 25° C ± 2.

** Foliar application of zinc was given twice at fortnightly intervals during the active growth period with a solution of 0·25% solution of zinc sulphate.

neutral reaction (pH 6·8-7·0) and medium in available zinc (DTPA extractable zinc—1·1 ppm). First fully opened leaves were collected when the heads were mature for harvesting. For CA assay the leaves were washed with three changes of glass-distilled water. Weighed amounts of the fresh leaves were macerated with 0 005 M solution of cysteine in a pre-cooled mortar and pestle. The resulting slurry was squeezed through four layers of muslin cloth and the filtrate was centrifuged at 8,000 rpm for 20 minutes at 0 to 4° C in a refrigerated centrifuge (K 70). The supernatant was used as crude enzyme source. Activity was determined mannometrically[7]. Protein in enzyme was determined by the method of Lowry *et al.*[5] using Bovine serum albumin as a standard. Total zinc was determined by atomic absorption spectrophotometer in leaves collected similarly which were washed with detergent (Teepol), 0·1 N HCl and distilled water, dried at 60° C, ground and digested using a diacid (Nitric Perchloric) mixture.

Results (Table I) indicated that both soil and foliar application of zinc increased the yield, total dry matter, leaf zinc content and CA activity significantly. Further, there was significant positive correlation between leaf zinc and CA activity ($r = 0·782$), leaf zinc and yield ($r = 0·685$) and CA activity and yield ($r = 0·737$). The correlation between CA activity and yield was better than that between leaf zinc and the yield. While the increase in leaf zinc content due to soil and foliar application of zinc was similar, the increase in CA activity due to foliar application of zinc was 50% more than that due to soil application. It has been suggested that while the leaf zinc content indicates the amount of total zinc present, the enzyme activity may serve as an index of the amount of active zinc present in the leaves[3]. Okhi[6] has observed in soybean that when the substrate zinc level was increased from 10 to 100 μg/l although leaf zinc content did not show any increase, the CA activity increased four fold and the symptoms of Zn deficiency were reduced to a trace. These results suggest that although based on increase in yield and leaf zinc content, the effects of soil and foliar application of zinc were similar, the data on CA activity indicated that foliar application of zinc may be better than soil application. The study also revealed that CA activity might serve as a better index of zinc nutrition of cabbage than leaf zinc content.

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SCAB OF *OCIMUM BASILICUM*—A NEW DISEASE CAUSED BY *ELSINOE ARXII* SP. NOV. FROM BANGALORE

WHILE screening F_2 segregants and parents of the varietal crosses of French basil (*Ocimum basilicum*) × Kamakasturi—(local variety of *Ocimum basilicum*) against *Cercospora ocimicola* ciferi a new disease causing scab symptoms on leaves and tender twigs was found consistantly associated. First it was thought that both the symptoms were due to one and the same fungus. However these symptoms could be distinguished on the basis that plants infected with *Cercospora* alone or both *Cercospora* and scab pathogen showed complete defoliation, whereas those which were having only scab symptoms showed little defoliation with puckering, cupping of the leaves and distortion of the tender twigs. This paper deals with the symptomatology, diagnosis and identity of causal organism of this new scab disease caused by a species of *Elsinoe*.

Symptoms Diagnosis and Pathogenicity Tests

The initial symptoms start as minute innumerable spots scattered or aggregated throughout the leaf surface either on one or both the leaf surface. These minute spots are either circular or irregular varying from 0·5 mm to 5 mm. When these numerous spots coalesce they may cover the entire leaf blade or one or few sector of the leaf blade. These infection spots constitute innumerable pin heads representing stroma of the ascomycete. Slight cupping and puckering of the leaves were also observed in some cases. When tender twigs are attacked they show the symptoms of distortion. Since no member of the family Labiatae was found infected by any species of *Elsinoe*, this fungus is described as new to science after Dr. J. A. Von Arx, a distinguish mycologist for his outstanding contribution to this field of science.

The fungus was isolated in pure culture on potato Dextorse Agar medium. Pathogenicity tests were