secretion to provide sugars from starch hydrolysis to sustain tube growth[6]. Pollen is a rich source of GA_3 and its content is reported to be 200-fold greater than that in ovary tissue both for *Petunia hybrida* and *Lilium*[7]. Pollen GA_3 should contribute little to total ovary level of GA at the time of pollination. Furthermore, only minor amounts of GA are known to diffuse from pine pollen into aqueous media during pollen germination[8]. The initial 'turnover' of GA during pollen viability and the formation of more active polar GA are correlated with rapid pollen tube growth[9].

ABA suppressed the elongation of pollen tube[10]. It has also been demonstrated in the present study that ABA has an inhibitory effect on pollen viability and tube growth in both the plants. The time of emergence of pollen tube was also delayed (150 sec) considerably when compared to control (45 sec). The inhibitory effect of ABA by exogenous application might be due to its interaction with endogenous ABA-like inhibitors, which suppress pollen tube growth.

As shown in table 2, the acceleration of tube growth was more evident in $GA_3 + IAA$ combination than in $ABA + GA_3$. The growth inhibition by ABA was overcome significantly in the presence of GA_3, rather than IAA, suggesting a favourable interaction between ABA and GA_3 in regulating pollen tube growth. ABA acts in a way antagonistic to the action of GA_3[11].

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STUDIES ON ZN DEFICIENCY IN DECIDUOUS SPECIES OF KUMAUN HIMALAYA I. EFFECT OF ZN ON CERTAIN FOLIAGE CHARACTERS OF *FRAXINUS MICRANTHA*

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THE relationship between nutrient status of the soil and foliage characteristic of woody plants is important both from the standpoint of nutrient cycling and as a specific plant adaptation[1]. In recent years studies have been made to examine the intraspecific responses of woody plants to nutrient status in terms of leaf longevity, leaf production and foliage constituents[2-5]. These studies indicate both increase and decrease in leaf longevity in response to increased level of macronutrients such as nitrogen, phosphorus and potassium. However, increased leaf production and nutrient enrichment of leaf are some of the consistent effects of mineral application.

The response of woody plants to micronutrient status in terms of foliage characters is less understood. The purpose of this communication is to determine the effects of Zn-status on leaf longevity, leaf production and foliage concentration of chlorophylls, protein and nucleic acids of *Fraxinus micrantha*. This species in certain forest stands, shows clear deficiency symptoms. The macronutrient status of the soil in these forest stands has been studied earlier (S. Yadav, Unpublished). In this study attempts have been made to understand whether or not the deficiency symptoms shown by *Fraxinus micrantha* are due to Zn. The effect of application of $ZnCl_2$, Zn EDTA and $ZnSO_4$ has also been studied.

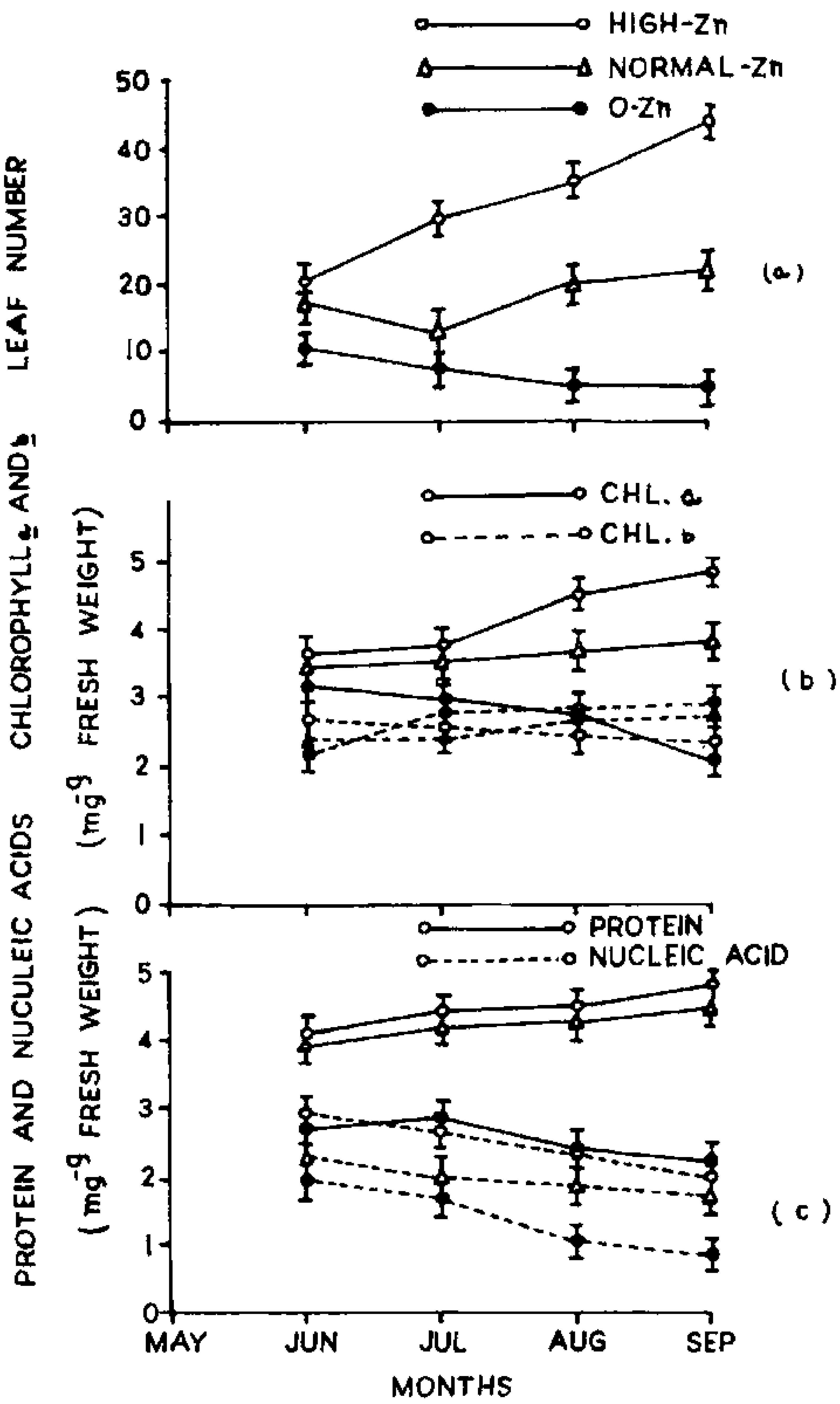
Fraxinus micrantha Wall (ash) is a winter deciduous tree of the mid-montane region of Kumaun Himalaya. Leaf production starts in April and leaf drop commences early in September and by late November the trees are bare.

Seeds of *F. micrantha* were germinated in vermiculite and one-month-old seedlings were grown at three Zn-levels in sand culture following the procedure of Kumar *et al*[6]. The experiments were conducted in the glass house of the Department of Botany, Kumaun University, Nainital. Sand was made free from nutrients by washing with tapwater, and then by adding 18 % concentrated HCl + 10 % oxalic acid solution and subsequently washing with water with pH 7. The traces of Zn were removed by the 8-hydroxy quinoline method. Zinc was supplied in the form of $ZnCl_2$ (5 mg/l). One set of plants was supplied with complete Hoagland's solution[7] and another with Hoagland's solution without Zn. Five seedlings of *F. micrantha* were grown at each of the three Zn levels referred to as O-Zn level (without Zn), normal Zn level (present in Hoagland's solution, 97 mg/l) and high Zn-level (5 mg/l extra to complete Hoagland's solution). Seedlings were grown till September and when leaf fall starts under natural forest conditions. Leaf number and leaf fall were observed after growing seedlings for two months at different Zn-levels. Longevity of leaves initiated earliest was observed under each treatment. Chlorophylls, protein and nucleic acids were estimated following the methods of Strain *et al*,[8] Lowry *et al*[9] and Smillie and Krotokov[10], respectively.

The leaf number increased markedly with the increased Zn supply (figure 1a). Seedlings at normal Zn level produced about three times as many leaves as did seedlings at O-Zn level and seedlings at high Zn level produced about twice as many leaves as did seedlings of normal Zn level. On an average, the longevity of the leaves was about 3-5 months at O-Zn level and about 5.5 months each at normal and high Zn level.

Both chlorophyll *a* and *b* contents in foliage not only increased in response to increased Zn level, but also showed increasing temporal trend until the culmination of the experiment (figure 1b). Lower concentrations of the nucleic acids and faster degradation of protein were observed in seedling grown in the medium devoid of Zn. High Zn level enabled the seedlings to maintain higher protein content as well as to retain it for longer duration.

The leaf fall was initiated quite early in seedlings grown in the medium devoid of Zn than in medium with normal and high Zn level, indicating that the moderate Zn-enrichment prolonged leaf longevity in *F. micrantha*. This contradicts the findings of Shaver[5] who reported increased deciduousness for a shrub (*Ledum palastra*) in response to NPK fertilization and is



Figures 1a–c. Effect of Zn level (normal, high and O-Zn) on different foliage characters in *Fraxinus micrantha* **a.** leaf number, **b.** chlorophyll *a* and *b* **c.** protein and nucleic acids.

consistent with the reports of Turner and Olsen[3] who found more evergreenness of *Pseudotsuga menzesii* at higher N level. However, no difference was found in the leaf longevity of seedlings grown in normal and high Zn level, the latter by shading out earlier leaves checked their longevity to the level attained by the leaves of normal Zn level (leafing continued for longer period at high Zn level, figure 1a). Increase in protein and nucleic acids content in response to Zn-enrichment was well marked (figure 1c). It has been reported that under Zn-deficiency several free amino acids accumulate, causing decrease in the total protein content[11]. A decrease in the rate of RNA formation, but not DNA, just prior to the onset of growth inhibition under Zn deficiency was also reported[12].

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WIDESPREAD INCIDENCE OF ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* ON COTTON IN PUNJAB (INDIA)

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ROOT-KNOT nematodes are widely distributed pests of agricultural and horticultural crops and cause enormous loss in the yield throughout the world. First incidence of root-knot nematode on cotton (*Gossypium arboreum* var *neglectum* f. *bengalensis*) in India, was observed in 1939 from Punjab state[1]. Abu Bucker and Seshadri[2] detected infestation of *M. incognita* on cotton in a field of South Arcot district. *M. javanica* was also encountered from 7 to 8% samples of cotton from some parts of Haryana and Punjab states[3].

During the *Kharif* season of 1985, while analyzing the cause of the large scale occurrence of wilt of cotton in Punjab, root-knot nematode infestation was found to be widespread. The nematode parasitized American (*G. hirusutum* L) as well as Desi Cotton (*G. arboreum* L), but the extent of galling was more on the latter. Subsequently a preliminary survey of Punjab was conducted and root-knot nematode infestation was observed in all the five districts, forming the cotton belt of the state.

Infestation of root-knot nematode, ranging from light to heavy on cotton was recorded from Dhilwan, Tapa Mandi and a number of other places.

Laboratory investigations revealed the occurrence of mature females with egg sacs and different developing stages of root-knot nematodes in the galled roots. Critical examination of the perineal region of females dissected out from acid fuchsin stained, galled cotton roots revealed the pattern to be similar to that of *M. incognita*. The head region of the males also resembled those of *M. incognita* as described by Eisenback *et al*[4]. In USA and some other countries, nematodes belonging to this species are recognized as a serious pest to cotton. Out of the four races, occurring in *M. incognita*, only race 3 and 4 attack cotton[4]. So far race 4 has not been found to occur in India[5-7]. From the northern part of the country only race 1 and 2 have been recorded so far[5,6]. Further studies are in progress to identify the race, widespread on cotton in Punjab.

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