was fairly rich in amino nitrogen and soluble sugars (Table 2). Chromatographic analysis indicated the presence of several amino acids. Barak *et al.*[11] demonstrated a positive response of *A. brasilense* towards several organic acids, sugars and amino acids. In recent years even strain-specific chemotaxis has been demonstrated in *Azospirillum*[12]. Maize and kallar grass (C4 plants) isolates of *Azospirillum* showed more chemotactic response to malic acid while isolates from C3 plants were attracted by amino acids and sugars.

The results indicate that root secretions of tobacco can not only serve as a source of energy for microorganisms but, perhaps more importantly, attract the diazotrophic bacterium *Azospirillum*. At present we do not know the chemotactic behaviour of the other three species of *Azospirillum*, *A. lipoferum*, *A. serapedica* and *A. amazonense*.

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Accumulation of choline and glycinebetaine in salt-stressed wheat seedlings

R. Krishnamurthy and K. A. Bhagwat
Department of Botany, Faculty of Science, M.S. University of Baroda, Baroda 390 002, India

Choline and glycinebetaine accumulation in 16-day-old salt-resistant wheat cv. Sonalica grown in medium containing 0 to 200 mM NaCl increased with increasing salinity in both shoots and roots. Per cent increase in accumulation was linearly correlated with salinity. The results are consistent with the hypothesis that choline and glycinebetaine are compatible cytoplasmic solutes involved in osmotic adjustment to salinity stress. We discuss the physiological significance of these quaternary ammonium compounds.

ALIPHATIC quaternary ammonium compounds, in particular glycinebetaine and choline, are found in a large number of plants, although their concentrations vary widely in different species[1], in different organs[2] and with age of the plant[3]. Glycinebetaine concentration usually exceeds that of choline and may even form a large percentage of the total plant nitrogen. Yet, the physiological function of quaternary ammonium compounds has received scanty attention. It has been suggested that these compounds may act as a major cytoplasmic osmoticum under conditions of low intracellular osmotic potential[4]. In previous reports, we have examined the relationship between salt tolerance and the endogenous concentration of glycinebetaine and total quaternary ammonium compounds in shoot and root systems during different stages of growth in rice[5,6]. We have found that the salt-tolerant cultivars of rice are highly efficient in maintaining high levels of glycinebetaine and total quaternary ammonium compounds than the salt-sensitive cultivars. In view of the findings concerning cellular and physiological processes involving glycinebetaine and choline that underlie salt tolerance of rice[5,6], wheat[7,8] and other plants[1], we did experiments to find the relationship, if any, between salinity levels of growth medium and concentrations of choline and glycinebetaine in shoots and roots of seedlings of a salt-resistant wheat cultivar, Sonalika.

Seeds of wheat (*Triticum aestivum* L.) cv. Sonalika (salt-resistant) were obtained from the Gujarat Agricultural University, Vijapur. Seeds of uniform size were surface-sterilized with 0.1% mercuric chloride for three minutes, and washed thoroughly with distilled water and blotted dry. These seeds were transferred to sterilized petri dishes containing Whatman No. 1 filter paper circles moistened with distilled water. The seeds were kept for germination for 5 days. Six-day-old seedlings were supplied unaerated nutrient solution[8] containing 0.025, 0.050, 0.075, 0.100, 0.125, 0.150, 0.175 or 0.200 M NaCl. NaCl was omitted from control nutrient solution. The nutrient solution was renewed twice a week. All plants were grown under conditions of 16 h light (with six 100 W incandescent lamps) and 8 h dark at $26 \pm 1^{\circ}C$. Shoots and roots were harvested 16 days after germination for estimation of choline and glycinebetaine. Choline and glycinebetaine were determined by the periodide-dichloroethane method[7], with modifications in the preparation of periodide reagent[9]. The data were statistically analysed for linear correlation[10].

Figure 1 shows that choline and glycinebetaine increased with increasing level of NaCl salinity in both shoots and roots. Even though choline and glycinebetaine are synthesized from the same precursor ethanolamine[11], choline content of shoots and roots always exceeded glycinebetaine at all levels of salt treatment (Figure 1*a*, *b*). Per cent increase in accumulation of these two compounds in both shoot and root were correlated linearly ($r=0.945$ to 0.998) with salinity of growth medium (Figure 2).

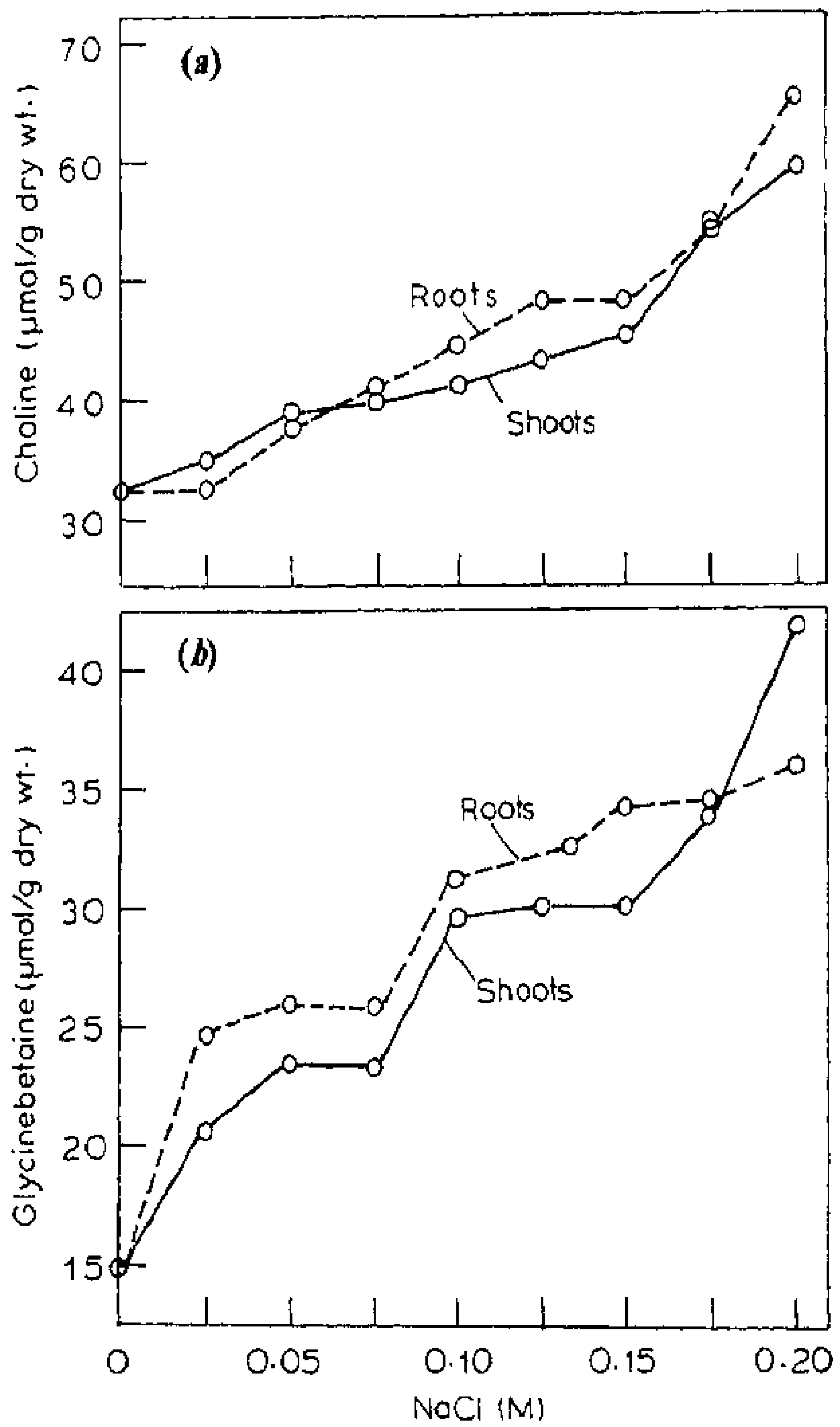

Figure 1. Choline (a) and glycinebetaine (b) accumulation in shoots and roots of wheat at different salinity levels of growth medium.

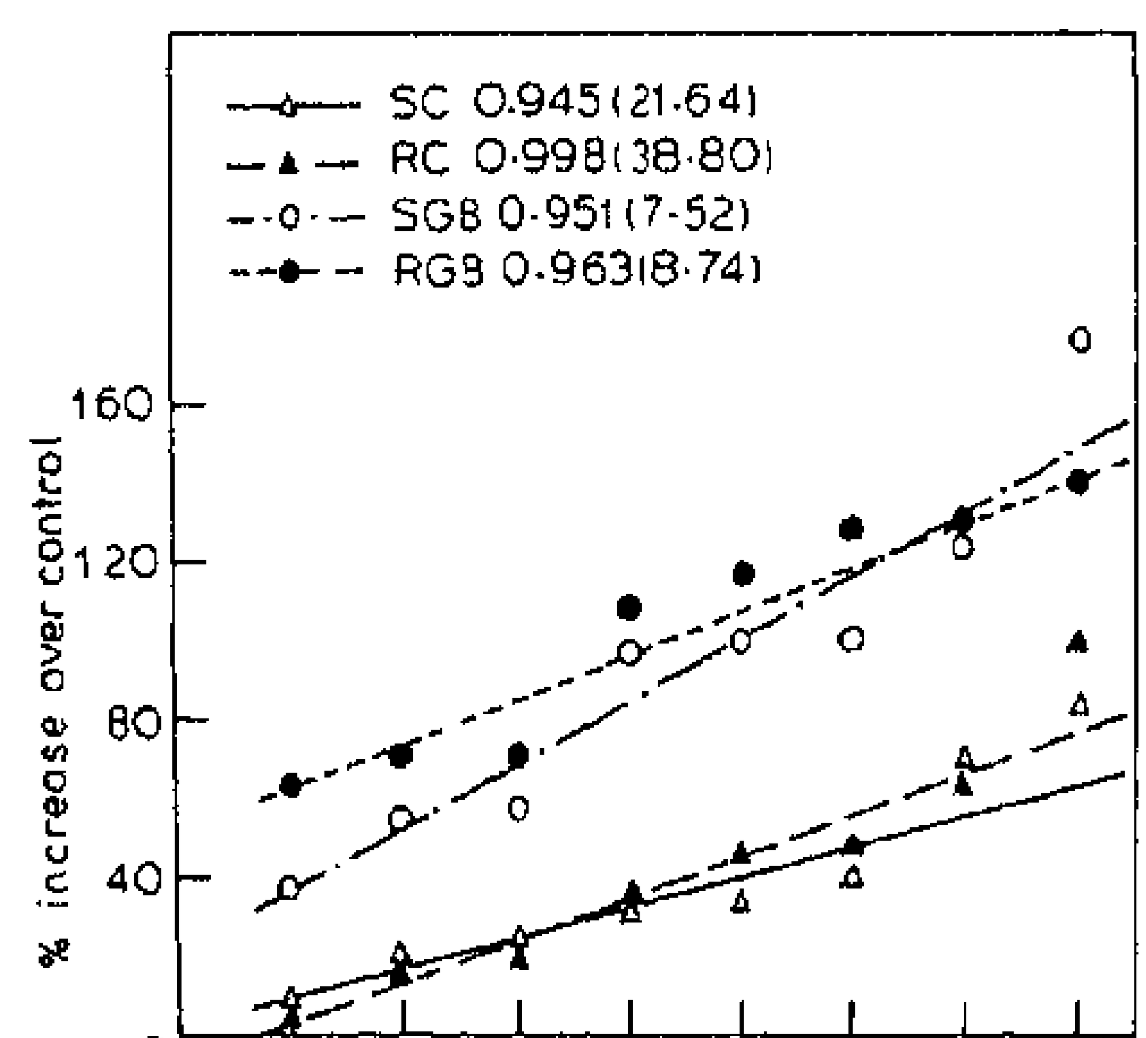

Figure 2. Linear relationship between accumulation of choline and glycinebetaine in shoots and roots of wheat seedlings and salinity of growth medium. SC, Shoot choline; RC, root choline; SGB, shoot glycinebetaine; RGB, root glycinebetaine. Figures in parentheses are t values.

It has been suggested that ethanolamine gets methylated thrice to produce choline[11]. The choline is further oxidized to glycinebetaine. There is a view that, once formed, glycinebetaine constitutes an inert end-product that is not further metabolized by the plant[11]. Although a precise physiological or adaptive role has not been assigned to choline and glycinebetaine, it is believed that these quaternary ammonium compounds may function as an organic nontoxic cytoplasmic osmoticum[4], associated with salt resistance[5,6], protection of enzymes against electrolyte inhibition[12], and increased membrane stability[13], thus representing an important adaptation of plants to water shortage[14].

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Increased acetylcholinesterase activity in aestivating snail *Trachia vittata* (Muller)

J. P. Arockiam
School of Biological Sciences, Madurai Kamaraj University, Madurai 625 021, India
Present address: Department of Zoology, St. Xavier's College, Palayamkottai 627 002, India

Acetylcholinesterase activity was significantly higher in nervous tissue, mantle fold and foot muscle of aestivating snails than in tissues of normal, active snails. Protein content of these tissues was decreased in aestivating snails. Increased acetylcholinesterase activity in some tissues may be a requirement in aestivation physiology.

ACETYLCHOLINESTERASE (EC 3.1.1.7) hydrolyses acetylcholine and is found in all classes of animals[1–3]. Acetylcholine, a well-known neurotransmitter, brings about diverse physiological functions in different tissues[4,5]. When it acts through a muscarinic cholinergic receptor, the phosphoinositide messenger system is stimulated[5–7]. Muscarinic cholinergic stimulation, depending on the tissue involved, regulates diverse