The variable orders in the substrate could be accounted for on the basis of relative magnitudes of $k_{-1}/k_2$ and [S]. Equation (1) can be rearranged to give (2).

$$1/\text{rate} = \frac{k_{-1}/k_2}{k_1[\text{Ru(III)}][\text{S}][\text{NMO}]} + \frac{1}{k_1[\text{Ru(III)}][\text{NMO}]} \quad (2)$$

Equation (2) has been verified by plotting 1/rate against 1/[S] using the data obtained for low concentrations of the substrate, at constant concentration of Ru(III) and NMO. At high substrate concentrations, $k_{-1}/k_2 < [\text{S}]$ and so the reaction is zero order in the substrate. A comparison (table 1) of the values of $k_1$ obtained from the linear plots with those obtained from the pseudo first order rate constants ($k_{obs}$) supports the proposed mechanism.

**Table 1** *Evaluation of rate constants from double reciprocal plots at low concentrations of substrate*

| Substrate | $k_1$ in $M^{-1}$ $min^{-1}$ From pseudo first order plots | From double reciprocal plots | $(k_{-1}/k_2)$ |
|---|---|---|---|
| Cyclohexene | 11.42±0.13 | 11.36 | 0.109 |
| 1-Octene | 8.43±0.34 | 8.30 | 0.053 |

Since the olefinic substrates can form complexes with transition metal ions, spectral studies are in progress to investigate this possibility. Further work in epoxidizing a variety of olefinic substrates as well as amines, sulphides, etc is in progress.

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## SALINITY STRESS RESPONSE OF PLANTS AND CALLI IN WHEAT

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FOLLOWING reports[1–3] of several fold intra-specific heritable differences in adaptation to saline environment, many investigators have advocated the use of tissue culture technique for identifying salt-tolerant genotypes for generating new genetic variability for this purpose[4–6]. This approach towards developing more salt-resistant crop varieties is supported by observations in several nonhalophytes revealing sizable inter-specific differences at the cellular level in respect of salt tolerance[7]. In addition, halophytes have developed more successful adaptive strategies, based on certain anatomical and morphological features, to live with excessive salt concentrations[8,9]. In this context, the present investigation on plants and calli of two wheat genotypes, vars HD 4502 and C 306, was undertaken to study their comparative response to salinity stress.

Plants were grown in 20 kg capacity glazed porcelein pots with four repeats, each having five plants. Saline soil grade (ECe 7.0 dS $m^{-1}$) was prepared following the procedure described in the US Salinity Laboratory Handbook No. 60 using NaCl. Salinity level was maintained by flushing and saturating the soil with saline water of 7.0 dS $m^{-1}$ conductivity. Controls were raised in non-saline soil under comparable conditions. Performance of var

C 306, under non-saline as well as saline soil conditions, was superior to that of var HD 4502 as shown by 5 different parameters excepting grain weight index (table 1). Stress-caused reduction in respect of these parameters was noticeably lower in the case of C 306.

For the response of callus cultures to salt stress, calli grown from embryonic axis of young seedlings were used. Var HD 4502 showed profuse callus induction on PRL 4 medium[10] with 2 mg/l of 2,4-D while C 306 responded well to M1 medium[11] supplemented with 5 mg/l NAA and 1 g/l of casein hydrolysate. In both the cases, however, the calli so induced were maintained on PRL 4 medium containing 1 mg/l 2,4-D. The effect of media, salinized with 0.5% and 1% NaCl concentration, on calli growth was studied using ten repeats for each treatment as well as for non-salinized medium that served as the control. Data on dry weight of calli, following 30, 45 and 60 days of culture, are presented in table 2. Growth rate of callus cultures of both varieties decreased with increase in NaCl concentration

**Table 1** *Effect of soil salinity stress (ECe 7 dS $m^{-1}$) on plant growth and yield parameters of two wheat genotypes*

| Parameters | Wheat genotypes | | | | | |
|---|---|---|---|---|---|---|
| | Var HD 4502 | | | Var C 306 | | |
| | Non-saline soil | Saline soil | Reduct-ion % | Non-saline soil | Saline soil | Reduct-ion % |
| Plant height (cm) | 69.24 | 46.51 | 32.8 | 98.49* | 80.82* | 17.4 |
| Ear-bearing tillers/plant | 3.55 | 1.32 | 62.8 | 4.40* | 1.85* | 57.9 |
| Ear length (cm) | 6.17 | 3.68 | 40.4 | 8.28* | 5.33* | 35.6 |
| 100–Grain wt.(g) | 4.36 | 3.47 | 28.5 | 4.29 | 3.26 | 24.0 |
| Grain yield/plant (g) | 4.76 | 0.88 | 81.5 | 5.97* | 1.35* | 77.4 |

* Values significantly different from those of Var HD 4502 at $P = 0.05$

**Table 2** *Effect of salinized media on growth of callus cultures of two wheat genotypes*

| Incubation period | Increase (%) in callus weight | | | | | |
|---|---|---|---|---|---|---|
| | Var HD 4502 | | | Var C 306 | | |
| | NaCl conc.(%) | | | NaCl conc.(%) | | |
| | 0·0 | 0·5 | 1·0 | 0·0 | 0·5 | 1·0 |
| 30 days | 50.51 | 28.43 (−43.7) | 2.80[a] (−94.5)[b] | 122.71 | 131.15 (+6.9) | 58.96 (−51.9) |
| 45 days | 157.58 | 49.69 (−68.5) | 10.26 (−93.5) | 357.63 | 290.69 (−18.7) | 126.20 (−64.7) |
| 60 days | 260.13 | 105.92 (−59.3) | 48.16 (−81.5) | 412.59 | 401.36 (−2.7) | 186.28 (−54.8) |

[a] All values under NaCl treatments were significantly different from those under the non-saline medium excepting those of Var C 306 under 0.5% NaCl after 30 and 60 days of incubation.

[b] Values in parentheses denote salinity-caused reduction (%) in relation to non-saline medium.

except a slight stimulatory effect of the lower concentration of NaCl (0.5%) in the case of C 306 calli at 30 days. The observed response to salinity was, however, remarkably different between the two genotypes. At both the NaCl concentrations and at 30, 45 and 60 days of growth C 306 calli showed higher salt tolerance as compared to those of var HD 4502.

*In vitro* and *in planta* responses to salt stress were of different magnitude, as expected. Inherent differences in salt tolerance at the cellular (calli) level are likely to be modified substantially through the superimposition of anatomical/morphological features of the adult plant. Significant differences in respect of calli growth response to salinity stress suggest that genetic variability of wheat germplasm collections needs to be studied critically for salt tolerance of their calli. Confirmation of genotypic differences in salt tolerance of calli by follow-up studies will open up new possibilities in breeding efforts directed towards genetic improvement of salt tolerance in wheat varieties.

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## VERTICAL BANDED BLIGHT—AN UNUSUAL MARASMIELLUS DISEASE OF MAIZE

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SINCE 1975, a widespread disease characterized by large, bleached, elongate lesions surrounded by irregular but vertically-oriented bands or zonations (figure 2b) has been observed to occur on maize foliage in Western Uttar Pradesh, Punjab, Haryana, Rajasthan and Madhya Pradesh in *kharif* (summer) crop season. The disease usually appears in August but no signs of a pathogen like fructifications, mouldy growth, etc are present. Periodic field observations showed that fungal fructifications develop in September particularly after rainy spells. In a gross way (with naked eye) they resemble irregularly curled but more or less discoid sclerotia of *Thanatephorus sasakii* Tu and Kimbr (*Rhizoctonia solani* Kuhn). With magnification these structures get resolved into agaricoid fructifications (basidiomata) complete with stipe and pileus. The basidiomata are highly evanescent and the time of collection is crucial for spotting them.

The association of an agaricoid fungus (Order Agaricales, Subdivision Basidiomycotina) with a leaf disease in maize is rather rare. Indeed this appears to be the first example of such a disease, though it possibly is similar to that reported by Latterell and Rossi[1] from Mexico, Costa Rica and Nicaragua in Central America. The species of *Marasmiellus*, found associated with it was not however determined. Since we have been able to collect fully mature fructifications containing basidiospores and since a technique to produce the basidiomata experimentally when needed has been devised, we document the identity and description of the species. In addition, a comparative account of symptomatology of this disease and the other caused by *Thanatephorus sasakii* (*Rhizoctonia solani*), known as Banded leaf and sheath blight, for designating the former with another common name disease, Vertical banded blight, is presented.