$HClO_4$ to extract the carnitine as before. To express the results on a fr. wt basis, 10 batches of air-dry grain (10 g each) were imbibed in 1% $CuSO_4$ for 24 hr. The $CuSO_4$ allowed imbibition but prevented germination. The grain was dried to constant wt at 110°. Fr. wt/air-dry wt ratios were found and the amount of carnitine/g fr. wt calculated. The assay of L-carnitine was according to the method of ref. [3], based on the principle of the technique used in ref. [4] employing acetyl CoA and carnitine-*O*-acetyltransferase (EC 2.3.1.7) (Sigma). The incubation medium was as described in ref. [3]. In this assay the percentage recovery of carnitine was 95–105% when known quantities of carnitine (2 nmol per g fr. wt) were added to extracts of plant material of known carnitine content. It was possible to determine as little as 10 pmol of L-carnitine with the assay procedure (accuracy ± 5%).

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PHOSPHATIDYLETHANOLAMINE IN WHEAT AND BARLEY LEAVES UNDER WATER STRESS

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Key Word Index—*Hordeum vulgare*; *Triticum aestivum*; Gramineae; barley; wheat; leaves; phosphatidylethanolamine; water stress.

Abstract—Phosphatidylethanolamine could not be detected in the leaves of less drought-tolerant varieties of wheat (S-308) and barley (BG-25) when the plants were subjected to water stress at tillering, ear emergence and grain filling stages. However, it remained unchanged in the more drought-tolerant varieties C-306 (wheat) and C-138 (barley). Upon release of stress by subsequent irrigation phosphatidylethanolamine reappeared in less drought-tolerant varieties.

INTRODUCTION

Water stress has inhibitory and sometimes devastating effects on almost all aspects of plant growth. Its adverse effects on carbohydrate [1], protein [2] and nucleic acid [3] metabolism are known, and recently [4] its effects on phospholipids have been studied. In a further study of the effect of water stress on leaf phospholipids some interesting observations were recorded concerning phosphatidylethanolamine.

RESULTS AND DISCUSSION

The phosphatidylethanolamine (PE) content of wheat varieties was in general higher than in the barley varieties. During growth, it decreased in both crops (Table 1). When irrigation was withheld for the creation of stress, PE disappeared in S-308 (wheat) and BG-25 (barley) while it remained more or less unchanged in the two other varieties. PE reappeared in S-308 and BG-25 upon release of stress by subsequent rewatering of plants stressed at tillering and ear emergence stages (Table 2).

PE is an important constituent of non-photosynthetic membranes such as mitochondria, endoplasmic reticulum, glyoxysomes and peroxisomes [5]. Changes in PE content have been reported during growth in pea and bean leaves [6] and wheat seedlings [7]. An inverse relationship between growth temperature and PE content has also been reported [8].

Under conditions of water stress, both in wheat

Table 1. Phosphatidylethanolamine content of wheat and barley leaves under water stress (mg/g dry wt)

	Tillering		Ear emergence		Grain filling	
	C	S	C	S	C	S
Wheat						
Cv S-308	0.28 ± 0.014	0.00	0.17 ± 0.09	0.00	0.05 ± 0.01	0.00
Cv C-306	0.30 ± 0.05	0.21 ± 0.02	0.20 ± 0.01	0.20 ± 0.02	0.08 ± 0.01	0.08 ± 0.01
Barley						
Cv BG-25	0.17 ± 0.04	0.00	0.10 ± 0.01	0.00	0.03 ± 0.01	0.00
Cv C-138	0.24 ± 0.01	0.22 ± 0.01	0.17 ± 0.04	0.17 ± 0.01	0.06 ± 0.01	0.06 ± 0.01

C, Control; S, stress. The results are the mean ± standard deviation of four replicate analyses.

Table 2. Phosphatidylethanolamine content of wheat and barley leaves after release of stress (mg/g dry wt)

Crop	S_1	S_2
Wheat		
Cv S-308	0.03 ± 0.007	0.02 ± 0.004
Cv C-306	0.08 ± 0.005	0.07 ± 0.003
Barley		
Cv BG-25	0.01 ± 0.008	0.01 ± 0.002
Cv C-138	0.06 ± 0.0008	0.06 ± 0.004

S_1 and S_2: Release of stress after tillering and ear emergence, respectively. The results are the mean ± standard deviation of four replicate analyses.

and barley, total phospholipid content of leaves has been reported to increase [4]. Therefore, the complete disappearance of PE in less drought-resistant varieties of wheat (S-308) and barley (BG-25) under water stress is of interest. The relevance of the PE changes to drought resistance is not known. Several criteria such as proline accumulation [9], peroxidase [10] and acid phosphatase [11] activity have been proposed as indices for stress tolerance. PE content may also serve as an indicator for selection of drought-resistant varieties just as Kuiper [8] suggested that PE can be used for selection of varieties of different cold hardiness.

EXPERIMENTAL

Two varieties of wheat, S-308 (less drought-tolerant) and C-306 (more drought-tolerant), and barley, BG-25 (less drought-tolerant) and C-138 (more drought-tolerant), were selected. The procedure for producing water stress and for lipid extraction and purification was achieved as described earlier [4]. Data are the mean of four replicate extracts analysed in duplicate.

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