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RESPONSE OF SEVERAL WHEAT GENOTYPES TO ZINC

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Abstract. The behaviour of twelve genotypes of wheat *(Triticum aestivum* L.*)* was evaluated at 0, 2.5 and 12.5 ppm zinc applied as $ZnSO_4$ under glasshouse conditions. Considerable variation among the genotypes was observed with respect to dry matter production, Zn concentration and Zn-uptake. Increase in dry matter yield at 2.5 ppm Zn application ranged from 3.7 to 84.9% and 2.6 to 41.3% in shoots and roots respectively. On the over all basis Lyallpur-73 and Yecora appeared to be the most susceptible while Mutant-17 to be least susceptible to change in dry matter yield, Zn concentration due to Zn.

Plants of different species are known to behave differently towards the same mineral environments[3,6] Even varieties within same species differ with regard to yielding capacity, mineral requirement and efficiency in nutrient uptake.[4] Cultivars of corn *(Zea mays* L.*)*, Sorghum *(Sorghum vulgare)* and Navy beans *(Phaseolus vulgaris* L.*)* have been reported to differ in their yielding capacity and response to Zn available in the growth medium.[2,5,9,11] A large number of wheat varieties are grown in Pakistan, but studies on the nutritional aspect of these varieties are generally lacking, particularly with respect to micronutrients. The soils of the Punjab have been reported as being deficient in micronutrients especially in Zn.[7,8] It would be of interest, therefore, to evaluate the influence of genetic variability among the wheat varieties on response to Zn. Such basic information would be of use to plant breeders as well to those who may be interested in evolving varieties that could suit a soil type.

Materials and Methods

A pot culture experiment was conducted in the glasshouse with twelve wheat varieties consisting of some promising mutants on an alkaline (pH 8.1) sandy loam soil from Chimranwali, Jhang containing 0.74 ppm DTPA-extractable Zn. Polythene lined plastic pots containing 1400 g soil were fertilized with 75 ppm N from urea and 50 ppm P_2O_5 and 27 ppm K from KH_2PO_4. Zinc treatments in triplicate were applied at the rate of 0, 2.5 and 12.5 ppm Zn as $ZnSO_4$ in solution form with first irrigation. Three plants were grown in each pot for 35 days (i.e. mid-tillering stage). Pots were maintained at 80% field capacity by the method of weighing. After harvest, shoots were washed with deionized water while roots were first washed with ordinary water jet and then dipped twice in deionized water. Weights of shoots and roots were recorded after drying at 70°. Zinc concentration in the shoots was determined by atomic absorption spectrophotometer after digestion in di-acid (HNO_3-$HClO_4$, 5:1) mixture.

Results and Discussion

There was considerable difference among the twelve wheat genotypes in percent dry matter yield response to Zn application (Table 1). The increase in dry matter yield of shoots and roots due to application of 2.5 ppm Zn ranged from 3.7% (Yecora) to 84.9% (SA–42) and 2.6% (Blue silver) to 41.3% (SA–42) respectively. Dry matter production was not increased significantly (P=0.01) by Zn rates greater than 2.5 ppm Zn for both shoots and roots. No P-Zn interaction was observed since the results were obtained under condition of one of P rate. The results were similar to that of Shukla and Raj[10].

Zinc concentration in the shoots of wheat genotypes varied significantly (P=0.01) depending on Zn treatments (Table 2). On an average variety Hira and Mutant–17 contained highest Zn concentration and variety Sanora the least. In control plants the concentration ranged from 12.7 ppm (Lyallpur-73) to 22.30 ppm (Mutant-17). Zinc concentration was also increased significantly (P=0.01) with the application of fertilizer Zn.. The increase in Zn-concentration at 2.5 ppm and 12.5 ppm level over no Zn ranged from 6.7% (Mutant-17) to 88.4% (Yecora) closely followed by Lyallpur-73 (81.9%) and 33.1%(Mutant-244) to 128.3% (Lyallpur-73) respectively. With the exception of Mutant-244 and Mutant-17, Zn concentration was always less than 19 ppm where no Zn was applied. Shukla and Raj[10] also reported response in wheat when shoot Zn concentration was less than 19 ppm in most of the varieties.

Similar to plant Zn concentration, the genotypes appeared to differ in their power for exploiting soil Zn under Zn stress condition. Barani-70 extracted low while Blue silver high amount of Zn from the soil

TABLE 1. SHOOT AND ROOT GROWTH IN WHEAT GENOTYPES AS AFFECTED BY Zn APPLICATION.

Genotypes	Zinc applied, ppm					Genotype mean*		Zinc applied, ppm					Genotype mean*	
	0	2.5		12.5				0	2.5		12.5			
	Shoot DMY gm/pot							Root DMY mg/pot						
1. Barani–70	1.19	1.25	(5.0)**	1.42	(19.3)	1.29	a	609	602	(–1.1)	822	(34.9)	678	a
2. Najjam-6	1.16	1.57	(35.3)	1.37	(18.1)	1.37	ab	695	837	(20.4)	854	(22.8)	796	a
3. Mutant–17	1.25	1.55	(24.0)	1.42	(13.6)	1.41	ab	496	615	(23.9)	614	(23.7)	575	a
4. Hira	1.47	1.70	(15.6)	1.66	(12.9)	1.61	abc	589	580	(–1.5)	562	(04.5)	577	a
5. Shammas–2	1.44	1.93	(34.0)	1.65	(14.6)	1.67	abc	703	866	(23.2)	715	(1.7)	762	a
6. Lyallpur–73	1.64	1.81	(10.4)	1.88	(14.6)	1.78	abcd	666	778	(16.8)	777	(16.6	741	a
7. Yecora	1.61	1.67	(3.7)	2.13	(32.3)	1.81	abcd	560	659	(17.7)	785	(40.2)	668	a
8. Mutant–244	1.50	1.93	(28.7)	2.19	(46.0)	1.87	bcd	754	810	(7.4)	898	(19.1)	820	a
9. Pari–73	1.76	1.88	(6.8)	2.07	(17.6)	1.90	bcd	664	764	(15.0)	795	(19.7)	741	a
10. Bluesilver	1.95	2.07	(6.1)	2.26	(15.9)	2.09	cd	739	758	(2.6)	740	(0.1)	746	a
11. SA–42	1.52	2.81	(84.9)	2.01	(32.3)	2.11	cd	601	849	(41.3)	752	(25.1)	734	a
12. Sanora–64	1.94	2.42	(24.7)	2.36	(21.6)	2.24	d	602	677	(12.4)	765	(27.0)	681	a
Treatment mean*	1.54 x	1.88	y	1.87	y			640 x	742	y	743	y		

TABLE 2. ZINC CONCENTRATION AND UPTAKE IN WHEAT GENOTYPES AS AFFECTED BY Zn APPLICATION.

Genotypes	Zinc applied, ppm.					Genotype mean*		Zinc applied, ppm					Genotyped mean*	
	0	2.5		12.5				0	2.5		12.5			
	Zinc conc., ppm							Zn uptake, ug/pot						
1. Barani–70	16.98	19.14	(12.7)**	36.19	(113.1)	24.10	ab	22.50	29.89	(32.8)	44.89	(99.5)	32.43	a
2. Najjam–6	17.25	23.75	(37.7)	63.83	(113.5)	25.94	ab	20.06	36.65	(82.7)	50.05	(149.5)	35.59	ab
3. Mutant–17	22.29	23.80	(6.7)	34.78	(56.0)	26.96	b	27.80	36.40	(30.9)	48.64	(74.9)	37.61	ab
4. Hira	17.65	30.57	(37.2)	34.51	(95.5)	27.58	b	25.25	47.91	(89.7)	55.65	(120.4)	42.94	bc
5. Shammas–2	15.66	19.72	(25.9)	27.66	(76.6)	21.01	ab	22.54	38.27	(69.8)	44.96	(99.4)	35.26	ab
6. Lyallpur–73	12.70	23.11	(81.9)	29.00	(128.3)	21.60	ab	20.40	38.56	(89.0)	52.60	(157.8)	37.19	ab
7. Yecora	13.50	25.44	(88.4)	26.97	(99.7)	21.97	ab	21.65	41.72	(92.7)	57.34	(164.8)	40.24	ab
8. Mutant–244	21.17	24.58	(16.1)	28.18	(33.1)	24.64	ab	30.07	45.58	(51.8)	61.40	(104.1)	45.68	bc
9. Pari–73	15.95	21.24	(33.1)	23.49	(47.3)	20.23	a	27.15	39.49	(45.4)	48.06	(77.0)	38.23	ab
10. Blue silver	16.53	24.94	(50.8)	33.64	(103.5)	25.04	ab	31.84	51.41	(61.4)	75.58	(137.4)	52.94	c
11. SA–42	18.21	22.33	(22.6)	25.81	(41.7)	22.12	ab	25.18	53.72	(113.3)	53.37	(111.9)	44.08	bc
12. Sanora–64	15.95	20.30	(27.3)	23.78	(49.1)	20.01	a	29.68	48.82	(64.5)	55.97	(88.6)	44.82	bc
Treatment mean*	16.99 x	23.24	y	30.06	z			25.35 x	42.36	y	54.04	z		

*Values followed by the same letter are not different at 1% level as determined by the Duncan Multiple Range Test. **Percent yield response given in parenthesis.

Zinc uptake was also increased considerably (P=0.01) with the application of Zn and ranged from 30.9% (Mutant-17) to 113.3% (SA-42) at 2.5 ppm Zn and 74.9% (Mutant-17) to 164.8% (Yecora) followed by Lyallpur-73 (157.8%) at 12.5% ppm Zn over that of control. Shukla and Raj[11] have reported that tissue Zn concentration was highest in the corn variety least susceptible to Zn deficiency and the least in the most susceptible variety. Depending upon foregoing discussion it can be inferred that Mutant-17 appeared to be least susceptible and Lyallpur-73 and Yecora to be be most susceptible to change in yield and Zn concentration due to Zn application under the present experimental conditions.

It is apparent from the results that all the wheat genotypes were susceptible to Zn deficiency in soil but differed in magnitude of expression. The reason for differential susceptibility of varieties to nutrient deficiency are not adequately known, although it has been suggested that they may be physiological in nature and as such controlled genetically.[9] Agarwala *et al.*[1] also indicated a possibility of genetic control as being responsible for differential susceptibility of some wheat varieties to Zn -stress. Shukla *et al.*[9] and Shukla and Raj[10] have reported that differential Zn response in sorghum and wheat genotypes was related to their capacity in exploiting soil Zn under Zn stress condition.

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