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# PHOSPHORUS AND ZINC NUTRITION OF TRITICALE (TRITICOSECALE WITTMACK) AND WHEAT (TRITICUM AESTIVUM L.) ON AN ALKALINE CALCAREOUS SOIL

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A field experiment on an alkaline calcareous soil was conducted to investigate P and Zn nutrition of triticale and wheat. In general, the grain yield of wheat was higher (P < .05) than that of triticale and the opposite was true as far as straw yield was concerned. Phosphorus application increased (P < .05) the grain and straw yields of both crops and Zn application had little effect. Lower response of triticale to applied P was attributed to its extensive root system which explored more of the native P. Applied P decreased Zn concentration (P < .05) because of dilution effect and Zn application had little effect on the P concentration of the two crops. Total uptake of P and Zn by triticale was higher (P < .05) than that of wheat.

Key words: Phosphorus; Triticale; Wheat; Zinc.

### INTRODUCTION

Field crops in general and wheat in particular respond to P application under calcareous soil conditions. It has become a general practice to apply P fertilizer along with N fertilizer to wheat crop. There are, however, some reports that P application induces Zn deficiency in crops [1, 2], while others [3] have shown P and Zn to be mutually antagonistic whenever either element exceeded some threshold value.

Kausar *et al.* [4] reported severe and extensive Zn deficiency in soils of Pakistan and suspected induced Zn deficiency due to applied macronutrient fertilizers, particularly on soils having marginal (< 1 ppm) amounts of available Zn. The present study on an alkaline calcareous soil was undertaken in the field to investigate the P and Zn nutrition of triticale and wheat.

#### MATERIALS AND METHODS

This experiment on triticale (T-183) and wheat (LU-26) was conducted at the NIAB farm. Some of the soil properties have been given in Table 1. Zinc at the rate of 0 and 10 kg ha<sup>-1</sup> as ZnSO<sub>4</sub> and P at the rate of 0, 75 and 300 kg ha<sup>-1</sup>  $P_2O_5$  as superphosphate were applied apart from a basal dressing of N at the rate of 100 kg ha<sup>-1</sup> as urea. Wheat and triticale were sown at the seed rate of 87 kg ha<sup>-1</sup>. After two months of growth, 100 mature leaves were collected randomly from each plot (5 x 3m). They were washed thoroughly with deionized water and dried at  $70^{\circ}$ . Grain and straw yields were recorded at maturity. Subsamples of grains and leaves were taken for P and Zn determination on a spectrophotometer and Atomic Absorption Spectrophotometer respectively after digestion with a diacid mixture of HNO<sub>3</sub> and HClO<sub>4</sub> in 4:1 ratio.

Root studies: Triticale and wheat were grown in glass cylinders of 5 cm diameter and 50 cm length containing 1500 g soil with basal doses of N and P at the rate of 50 and 25 ppm respectively. Moisture was maintained at 60% of the field capacity by the daily addition of deionized water. Moisture was maintained at 60% of the field capacity to avoid the saturation of the top soil for longer time which could adversely affect the plant growth in relatively narrow cylinders. The plants were harvested after 36 days of growth. After recording the dry weights of roots and shoots, they were analysed for P.

#### RESULTS AND DISCUSSION

Effect of phosphorus application on the yield and phosphorus uptake by wheat and Triticale: Applied P increased the grain and straw yields (P < .05) of triticale and wheat (Table 2). Data regarding the % response revealed that grain and straw yields of wheat due to P application were affected to a greater extent than those of triticale. Both levels of P in wheat and only higher level (P 300) in triticale increased the P concentration of leaves and grains of the two crops. Total contents as well as P concentration in leaves and grains of triticale were higher than that of wheat at all levels of P application (Tables 3 and 5). The lower response of triticale to applied P could be attri-

Table 1. Some properties of the soil used in the experiment.

Property	Unit	Value
pH of the saturated paste	_	7.95
Electrical conductivity of	mmhos cm <sup>-1</sup>	1.50
the saturation extract		
DTPA extractable Zn	ug g <sup>-1</sup>	0.42
HCO <sub>3</sub> extractable P	ug g <sup>-1</sup>	6.00
CaCO <sub>3</sub> equivalent	%	3.50

buted to its root system which might have explored more of the native nutrients from the soil. This is clear from the data of P and Zn concentration in leaves and grains (Table 3) of the triticale at control (P < .05). In a complementary pot experiment, triticale showed to have extensive root system than that of wheat (Table 4). Its root weight was also higher. Phosphorus concentration in shoots and roots of triticale were found similar to those of wheat. But total P contents were higher which indicated the better efficiency of triticale.

Applied P had little effect on the Zn concentration in leaves while it decreased (P < .05) Zn concentration in grains of both the crops. This decrease was attributed to the increased grain yields obtained by the applied P resulting in dilution of Zn in the grains. Other workers [5] have also reported similar results. In a case so reported, more than a

Table 2. Effect of P and Zn application on the grain and straw yield of wheat (LU-26) and triticale (NIAB T-183)

(-) 89		(-)4			Yield Kg ha <sup>-1</sup>					
	Grain			13.12(-8.9)			Straw	Straw/grain ratio		
Treatment	Wheat	Response %	Triticale	Response %	Wheat	Response %	(Triticale	Response %	Wheat	Triticale
Control	3634	(+ 24 <u>-</u> 0)	3747	9.99 24.04	4177	_	8627	- 150	1.15	2.30
Zn 10	3449	- 5.1	3820	+ 1.9	4383	+ 4.9	7887	- 8.6	1.27	2.06
P 75	4563	+ 25.6	3993	+ 6.6	7100	+ 70.0	9980	+ 15.6	1.56	2.50
P 300	4865	+ 33.9	4200	+ 12.1	7106	+ 70.1	10713	+ 24.2	1.46	2.55
P 75 Zn 10	4691	+ 29.1	3760	+ 1.3	6767	+ 62.0	9693	+ 12.4	1.44	2.58
P 300 Zn 10	4929	+ 35.6	4207	+12.3	7237	+ 73.3	10127	+ 12.4	1.47	2.41
Zn			N.S.			N	I.S.			
LSD P		2	234.92			587	.28			
(0.05) V	ie the gra	hy argas, Whi	23.73	ai qoro-elde	35	380	.72	e applicatio	of Zin	Effect

Table 3. Effect of P and Zn application on P and Zn concentration in wheat (LU-26) and triticale (NIAB T-183).

				P%	Zn ppm					
	an internet	Grain		Leaf		Grai	n	L	Leaf	
Treatment	Whea	at Tri	ticale	Wheat	Triticale	Wheat	Triticale	Wheat	Triticale	
Control	.25	it. Giwigen i	.40	tined) ods ens .21	.27	21.8	24.7	16.1	19.2	
Zn 10	.25	an io nanas	.34	.20	.23	22.9	33.3	16.3	20.0	
P 75	.30	a appropriation	.40	.23	.27	17.9	23.3	16.1	19.0	
P 300	.30	us national	.43	.25	.30	17.9	18.7	15.7	17.5	
P 75 Zn 10	.27		.41	.24	.29	21.2	29.4	15.2	20.9	
P 300 Zn 10	.30	WINDING	.42	.25	.32	19.8	29.1	14.5	21.7	
	Zn	Zn N.S.		N.S.		1.7421		N.S.		
L.S.D.	P	.0139		.0207		1.6828		N.S.		
(.05)	V	.0172		.0116	STUDIER'	1.4	951	1.01	125	

twofold increase in corn yield due to applied P had no significant effect on total Zn uptake [6].
Table 4. Shoots and roots weight and P composition of triticale and wheat grown in the cylinders

	Dry y	weight oot <sup>-1</sup>	Рсо	nc. %	Total contents $\mu g \text{ pot}^{-1}$		
er eifficien-	Tops	Roots	Tops	Roots	Tops	Roots	
Wheat	0.59	0.59	0.26	0.22	1510	1301	
Triticale	0.85	0.76	0.21	0.19	1837	1493	

In general, the grain yield of triticale was lower while it produced an appreciably higher straw yields than that of wheat. Straw/grain ratio in triticale was approximately double (2.4) that of wheat (1.4) which was attributed to very high vegetative growth and shrivelled grains to some extent. On the whole, Zn contents of triticale grains and leaves were higher (P < .05) than that of wheat. This could be attributed to its extensive root system.

# CONCLUSIONS

Greater uptake of native P and Zn from the soil by triticale suggests that it could be a successful and profit-

Table 5. Total contents of P and Zn in wheat and triticale grains as affected by P and Zn application.

			P con	itents			Zn contents				
Treatment Canada as		) stan	Wheat (kg ha <sup>-1</sup> )	ywdd of wh	Triticale (kg ha <sup>-1</sup> ) composition of the			Wheat (g ha <sup>-1</sup> )			
Control			9.32 (- )		14.40 (- )		79 (–)	3 3	89 (–)		
Zn 10			8.74 (-6.4)		13.12(-8.9)		79 (-)		126 (+ 41.6)		
P 75			13.79 (+ 47.8)		15.78 (+ 9.6)		82 (+ 3.8)		91 (+ 2.2)		
P 300			14.59 (+ 56.5)		17.99 (+ 24.9)		87 (+ 10.2)	)	78 (- 8.1)		
P 75 Zn 10			12.51 (+ 34.1)		15.39 (+6.9)		100 (+ 26.6)	)	109 (+ 22.5)		
P 300 Zn 10			15.06 (+ 61.4)		17.87 (+ 24.1)		98 (+ 24.0)	) pa ar	122 (+ 27.0)		
		Zn		N.S.			3.79				
LSD											
(.05)		Р		.9248			N.S.				
18.2	-	V	e de la composition de	,8288		1.4	6.24		0.8810		

Figures given in the brackets indicate % decrease or increase over control.

Effect of Zinc application on the yield and Zinc uptake of triticale and wheat: Applied Zn had little effect on the grain and straw yields of the two crops (Table 2). Lack of response to applied Zn was attributed to higher plant and soil Zn being higher than the critical levels (15 and 0.34 ppm respectively) [7, 8]. In addition, wheat among the cereals is less sensitive to Zn deficiency [9]. Triticale appears to be even a better explorer of native Zn.

Zinc application increased (P < .05) concentration and total uptake of Zn in grains of wheat and triticale (Tables 3 and 5) while in leaves it remained unaffected. Higher Zn concentration in leaves of triticale than that of wheat was accounted for higher Zn concentration in its grain. Applied Zn had no effect on the concentration and total uptake of P in grains and leaves (Table 3 and 5) of both the crops. Olsen *et al.* [9] have comprehensively reviewed various interactions in the plant nutrition. able crop in low fertility areas. While the grain yield of triticale is lower than that of wheat, its grain is higher in P and Zn, while its straw yield is considerably higher making it suitable both for human and animal consumption.

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#### INTRODUCTION

Online three, Farias takent Lind, have been observed to be serious pests of quines in Swat. Three puncture the epidermal layer of the leaves from which the sep oocas out in the form of deeplets. Leas of the wey causes separation of the apidermal layer from charophyll in the vicinity of the punctured area resulting in whitch streaks or spots out the leaves initially the young leaves are more affected, and show a yellowish green colour, especially at the head portion. With the passage of time the leaves turn whitch is portion. With the passage of time the leaves turn whitch portion which the passage of time the leaves turn whitch there is and show a vellowish green colour, especially at the head portion which the passage of time the leaves turn whitch portion and fangal spores adhere to the say droplets. Thus there are also gan entry through the feeding punctures between [2]. It was therefore, considered necessary to assess the effectiveness of some insecticide agains the perting the effectiveness of some insecticide agains the perting the effectiveness of some insecticide agains the perting the two control of T. mound and the point to give the effectiveness of the tot of the passary to assess affective control of T. mound and the combination with other products [8, 9] has even good control of T. adved products [8, 9] has even good control of T. adved

#### MATERIALS AND METHODS

A field experiment was carried out in randomized complete block design at the Agricultural Research Station. Mingora (Swat) Check and treatment plots measured 4.5 x 3.6 m and were replicated five times. Iteatments and replicates were bufferred usely neutral spacings (tidges), Onion pursery (cs. Swat Local) wes transplotted on February 2, 1935 in the expedimental field at spacings of

0.075 and 0.4m between plants and rown (lines), mapped gively.

RPMC (10% FC (Bossa), cypermetrinin 10% FC (Arrivo), experimetrinin 3% FC (Bestox), dritametrinin 0.025% FC + fritacopinos 14% fC (Docis Hild), methanitdophos 60% SL on May 27, 1985 at the rates grow in Table 1 using a compressed an apayer Five leaves were plucked gently, issue a small rance thate, from the plants relacted randomly in each plot/replacation and collected reparately in plastic bags file day bolore and the day onwark after application, file collected leaves were recorded. Fastic bags were jorked over a while paper for observing the dutips that have escaped the leaves if any. Data obtained thates transformed into log x or log x + 1.5 and subjected to analysis of variance. Means were compared through

#### RESULTS AND DISCUSSION

Table 1 shows that three domitics leaf during four days after spraying were significantly reduced in plear of experimethrin, deltamethrith + triaxophos, methamidophos and methonsyl in comparison to plots of BPMC and no treatment. Cypermethrin at both levels revealed a mailar level of reduction in the thrip population. Reduced numbers of *T trabars* on foliage nine days after spraying is probably explained by its left of population the soil [10]. Fifteen days after spraying thrip numbers showed a tendency to increase to plots treated with BPMC methemidency to increase to plots treated with BPMC methemidency to increase to plots treated with BPMC methemitering other hand thrip moments were relatively