

‘On-farm’ Seed Priming with Zinc in Maize, Wheat and Chickpea

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INTRODUCTION

Zinc deficiency is common in soils throughout the developed and developing world White and Zasoski (1999). The lack of Zn can limit the growth and productivity of a wide range of crops. In developed countries, fertilizers containing Zn are commonly added to soils where necessary, and it can also be effective to use foliar sprays. However, the use of these methods is much less common in developing countries.

In this paper, we investigated the potential for resource-poor farmers to use ‘on-farm’ seed priming (Harris 2006) before sowing to increase the amount of Zn in and on seeds and to improve the productivity and profitability of the major cereals maize and wheat, and the important legume chickpea thereby.

METHODS

In vitro, mini-plot and research-station trials were conducted at the NWFP Agricultural University research station, Peshawar, Pakistan, whereas farm fields in the district of Karak and Nowshera were used for researcher-implemented RBD trials and for farmer-implemented farmer-participatory (FAMPAR) trials. All sites have a semi-arid, hot, subtropical, continental climate and moderately to strongly calcareous soils of pH 8.1-8.3. Mean annual rainfall is similar in Peshawar and Karak (around 350 mm y⁻¹) whereas Nowshera receives around 550 mm y⁻¹. Maize is grown in the spring (mid-February to the end of March) and in summer (June to mid-July) and irrigated wherever possible. Wheat and chickpea are grown as *rabi* (post-monsoon) crops from October to March. Wheat is generally irrigated, but chickpea is mostly grown on residual moisture.

Crops grown from non-primed seed were compared with crops from seed primed with water or with an aqueous solution of ZnSO₄. Fertilizer grade ZnSO₄ (Zn 22.5%, S 12% and pH 3.0) was used to prepare the appropriate concentrations of priming solution (see footnotes in Table 1). All trials (using cv. Kissan-90 for maize, cv. Beetle-98 for chickpea and cv. Gazanavi-98 or cv. Tatara for wheat) were grown as randomised complete block designs with 3 or 4 replications or as FAMPAR trials with farmers as replicates. Data from all trials were pooled for each crop and analysed using GLIM of Minitab 14.

RESULTS AND DISCUSSION

Priming seeds with ZnSO₄ solutions increased grain yield significantly in maize by 27%, in wheat by 17% and in chickpea by 18% across a wide range of production environments (there were no significant trial x treatment interactions). These increases are similar to results reported for wheat (16%) and maize (26%) by Harris et al (2005, 2007) in response to adding the recommended rates of ZnSO₄ to these soils. For maize and wheat (and chickpea, but not significantly), priming seeds with water alone gave also significant yield benefits over using non-primed seed. In all three crops, around half of the effect of priming with Zn was attributable to the effect of priming *per se* and half due to the elemental effect of Zn (Table 1).

Benefit : cost ratios for seed priming with Zn were about 230 for maize (Harris et al. 2007), 360 for wheat and 1500 for chickpea (Harris et al. 2005) in comparison with 15 and 8 for soil application in maize and wheat, respectively.

Table 1. Mean grain yield of maize, wheat and chickpea in response to priming seeds with water or with ZnSO₄ solution before sowing. Within each crop, means followed by the same letter do not differ at P<0.05.

Crop	No. trials	Yield range (SE)	Grain yield (kg ha ⁻¹)			LSD (0.05)	Sig.
			Not primed	¹ Primed H ₂ O	² Primed Zn		
Maize	7	1892-4353 (106)	2970 ^a	3390 ^b	3775 ^c	183	***
Wheat	9	1093-3810 (71)	2393 ^a	2579 ^b	2801 ^c	112	***
Chickpea	7	1043-2023 (116)	1367 ^a	1474 ^{ab}	1609 ^b	197	*

¹Maize was primed for 16 h, wheat for 10 h and chickpea for 6 h. All primed seeds were surface-dried to facilitate handling before sowing.

²The concentration of Zn used was 1% w/v for maize, 0.3% for wheat and 0.05% for chickpea.

CONCLUSIONS

Priming seeds of maize, wheat and chickpea with dilute solutions of ZnSO₄ was effective in raising grain yields by amounts equivalent to those obtained using much larger amounts of soil-applied ZnSO₄. About half of the increase was due to the effect of priming *per se*, and half was due to the elemental effect of Zn. Seed priming is a cost-effective method of increasing yield and improving grain quality in these crops and is appropriate for resource-poor farmers.

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