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SEED PRIMING IN ZN SOLUTIONS ENHANCES EMERGENCE AND YIELD OF CHICKPEA

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ABSTRACT

In order to study the effect of zinc priming on chickpea, an experiment was conducted at Agricultural Research Farm of NWFP Agricultural University Peshawar during Rabi 2002-2003. The experiment was laid out in Randomized Complete Block design with four replications. The seeds of chickpea variety 'Karak-1' were primed in water as well as 0.05% and 0.075% Zn solutions. Dry seeds (non primed) were used as control treatment. A plot size of 15 m by 4 m with row to row distance of 30 cm was used. Analysis of the data indicated that seed priming with Zn significantly improved seeds emergence, grain yield and biological yield of chickpea. Seeds primed in 0.05% Zn solution resulted in highest emergence, grain and biological yields of chickpea. In conclusion it can be recommended that seed priming in Zn solutions does improve the seed emergence, grain yield and biological yield of chickpea crop.

Keywords: Chickpea, Zinc, Boron, seed priming, emergence, grain and biological yield.

INTRODUCTION

Chickpea (*Cicer arietinum* L.), commonly known as gram, is the fifth most important legume crop in the world, after soybean, groundnut, dry bean and pea. It is the major pulse crop with respect to consumption and cultivated area in Pakistan. The annual production varied from 767.1 to 397 thousand tons due to fluctuation in its productivity during 1997-98 to 2000-01, respectively (Anonymous, 2001). Seed quality (viability and vigor) has got profound influence on the stand establishment and crop yield. Healthy plant with well developed root system can more effectively mobilize limiting nutrients from the soil and can better withstand adverse conditions (e.g. dry spells). Vigorous early seedling growth has been shown to be associated with higher yield (Harris *et al.,* 2000). The vigor of seeds can be improved by techniques generally known as seed priming, which enhances the speed and uniformity of germination (Heydecker *et al.,* 1975). Seed priming comprises the soaking of seed in water and drying back to the storage moisture until use. On-farm seed priming is a simple, low-cost, and risk-less technology that has been successful in improving emergence, seedling vigor and yield in a range of crops, including legumes (Harris *et al*., 1999; 2001; Park *et al*., 1999; Mussa *et al*., 2001).

Crop production is also affected by soils deficient in P and Zn (Ryan, 1997). Especially during the early growth stages, lack of P and Zn retards seedling growth, rendering the young plantlets sensitive to the frequently encountered dry spells (Jones and Wahbi, 1992). Rapid establishment of healthy seedlings and an adequate supply of P and Zn are prerogative to reduce the risk of crop failure (Brown *et al.,* 1987). Nutrient priming has been proposed as a novel technique that combines the positive effects of seed priming with an improved nutrient supply (Al- Mudaris and Jutzi, 1999). In nutrient priming, seeds are pretreated (primed) in solutions containing the deficient nutrients, instead of being soaked simply in water. This alternative approach involves soaking seeds in dilute solutions before sowing.

It is now well established that 'on-farm' seed priming with water alone is effective in substantially increasing yields of chickpea (Harris *et al.,* 1999; Mussa *et al.,* 2001) and wheat (Harris *et al.,* 2001) in South Asia. There are several advantages of using seed priming; micronutrients adequately supplied to the seeds, uneven application of zinc to the soil is avoided as each seed is exposed to the nutrient, uptake is guaranteed, and the amounts required are likely to be less in magnitude than that for soil application. Conversely, the risk of toxicity may be increased by priming. The instant research experiment was therefore conducted with the aim to evaluate the effect of seeds primed in Zn solutions on seeds emergence and yield of chickpea crop.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at Agricultural Research Farm, Khyber Pakhtunkhwa Agricultural University Peshawar. Peshawar is located at 34°N, 71.3°E at an altitude of 450 m above sea level, about 1600 km north of Indian Ocean and has a continental climate. The experimental site has a soil pH of 8.3, with silty clay loam texture, derived from piedmont alluvium, moderately calcareous (12% lime). Organic matter is less than 1%. Canal irrigation is available with a very low zinc level.

Experimental details

The experiment was laid out in Randomized Complete Block design with four replications. Seeds of chickpea variety Karak-1 were primed in water, 0.05% and 0.075% Zn solutions using $ZnSO_4$ as a source of Zn for 12 hours. Dry non primed seeds were used as a control treatment. Seeds were sown on October 19th, 2002-2003 with the help of hand hoe at a seeding rate of 60 kg ha^{-1}. A plot size of 15 m by 4 m with row to row distance of 30 cm was used. The nutrients, N and P were applied at the rate of 25 and 90 kg ha^{-1}, respectively at the time of sowing using Urea and Single Super Phosphate (SSP) as N and P sources, respectively. The remaining cultural practices were applied uniformly to all the treatments. Data were recorded on emergence m^{-2}, pods plant^{-1}, grains pod^{-1}, grain yield and biological yield.

Statistical Analysis

The data were statistically analyzed using analysis of variance appropriate for randomized complete block design. The treatment means were then compared using LSD test at 0.05 level of probability (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Emergence m^{-2}

Perusal of the data (Table 1) indicated that seed priming significantly affected emergence m^{-2} of chickpea. Seed primed in 0.05% Zn solution resulted in higher emergence m^{-2} (37.4) followed by seed soaked in 0.075% Zn solution (34.1). Minimum emergence m^{-2} (26) was recorded for control plots. Nutrient priming has been declared effective in improving emergence and crop stand establishment (Harris *et al*., 1999; Mussa *et al*., 1999; Harris *et al*., 2000). These results are therefore in agreement with Chhipa *et al*. (1993), Rashid *et al.* (2000) and Ghosh *et al.* (1997) who reported higher grain yield for seed priming as compared with control treatments. The results also confirm the findings of Park *et al.* (1999), Arif *et al.* (2003) and (2005) that primed seeds in the field trials improved germination, emergence and stand establishment. Likewise Harris *et al.* (2001) reported improvement in germination, reduction in germination time and enhanced emergence in water primed seed.

Pods plant^{-1}

Data regarding pods plant^{-1} (Table 1) showed that seed priming did not significantly affect pods plant^{-1} of chickpea. This may disclose the fact that pods number is not significantly influenced by seed priming. However, seed primed in 0.05% Zn solution produced more pods plant^{-1} (14.7) than seeds primed in 0.075% Zn solution (13.8). Minimum pods plant^{-1} were produced by seeds soaked in water (13.4). Increase in number of pod plant^{-1} has also been reported by Mussa *et al*. (1999).

Number of grains pod^{-1}

The seed priming did not significantly affect number of grains pods^{-1} of chickpea (Table 1). However, seeds soaked in water resulted in greater number of grains pods^{-1} (2.1) followed by control treatment (2.0). Minimum number of grains pods^{-1} was produced by seeds primed in 0.075% Zn solution (1.7). The results agreed with the findings of Pongkao and Yothasiri (1995) who correlated increase in yield with increase in number of grains pod^{-1} and pods plant^{-1} through seed soaking in water.

Grain yield (kg ha^{-1})

Data regarding grain yield, presented in Table 1, indicated significant effect of seed priming on grain yield of chickpea. Seeds primed in 0.05% Zn solution produced 36% higher grain yield (2335 kg ha^{-1}) than control plots (1497 kg ha^{-1}). Nutrient priming does improve crop stand establishment, which consequently enhance drought tolerance, reduce pest damage, and increase crop yield (Harris *et al*., 1999; Mussa *et al*., 1999; Harris *et al*., 2000). These results are in agreement with Chhipa *et al*. (1993), Rashid *et al.* (2000) and Ghosh *et al.* (1997), who reported higher grain yield for seed priming as compared with control.

Biological yield (kg ha^{-1})

Perusal of the data (Table 1) indicated that seed priming also significantly affected the biological yield of chickpea. Seeds primed in 0.05% Zn solution produced highest biological yield (3808 kg ha^{-1}) followed by seeds soaked in water (3228 kg ha^{-1}). Minimum biological yield (2454 kg ha^{-1}) was produced by dry seeds (non primed control). The increase in biological yield might be due to better early seedling growth and plant nutrition as reported by Zhang *et al.* (1998). Chhipa *et al*. (1993) reported increase in straw yield by priming as compared with no soaking, which indicates an agreement with these results. Rashid *et al*. (2000) discovered that priming significantly increased total biomass and dry weight as compared with control.

Table 1. Effect of Zn priming on emergence, pods plant^{-1} and grains pod^{-1} of chickpea.

Treatments	Emergence m^{-2}	Pods plant^{-1}	Grains pod^{-1}
Dry seeds	26.0 b	13.7	2.0
Water primed seeds	33.3 b	13.4	2.1
0.05% Zn	37.4 a	14.7	1.9
0.075% Zn	34.1 b	13.8	1.7
LSD	10.01	NS	NS

Means of the same category followed by different letters are significantly different from one another.
NS = non significant

Table 2. Effect of Zn priming on grain yield and biological yield of chickpea.

Treatments	Grain yield (kg ha^{-1})	Increase over control (%)	Biological yield (kg ha^{-1})
Dry seeds	1497 c	0	2454 c
Water primed seeds	1979 b	24	3228 b
0.05% Zn	2337 a	36	3808 a
0.075% Zn	1577 c	5	2572 c
LSD	353.62		573.28

Means of the same category followed by different letters are significantly different from one another.

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