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Energy Efficiency Management (EEM) by Use of Nanoparticles in Maize Seedling Growth

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ABSTRACT

In order to the nanoparticles effect on seedling vigour index in maize (Zea mays L.), this experiment was conducted in 2011 by a factorial design with four replications. The factor was included use of TiO_2 nanoparticle (0, 0.02, 0.03 and 0.04 percentage). The results showed that the effect of nanoparticle was significant on germination percentage, seedling vigour, seedling length and seedling dry weight in maize. Means comparisons showed that the highest germination percentage, seedling vigour, seedling length and seedling dry weight were achieved under use of 0.03 percentage TiO_2 nanoparticle. The results showed that use of nanoparticles can increased seedling vigour index in maize that can increase energy efficiency management (EEM) for achieved to the sustainable agriculture.

Keywords: Energy Efficiency Management (EEM), nanoparticles, economical strategy, maize (*Zea mays* L.).

INTRODUCTION

To better understand seed germination, a complex developmental process, developed a proteome analysis of the model plant Arabidopsis for which complete genome sequence is now available. Among about 1,300 total seed proteins resolved in two-dimensional gels, changes in the abundance (up- and down-regulation) of 74 proteins were observed during germination sensu stricto (i.e. prior to radicle emergence) and the radicle protrusion step. This approach was also used to analyze protein changes occurring during industrial seed pretreatments such as priming that accelerate seed germination and improve seedling uniformity. Several proteins were identified by matrix-assisted laser-desorption ionization time of flight mass spectrometry. Some of them had previously been shown to play a role during germination and/or priming in several plant species, a finding that underlines the usefulness of using Arabidopsis as a model system for molecular analysis of seed quality. Furthermore, the present study, carried out at the protein level, validates previous results obtained at the level of gene expression (e.g. from quantitation of differentially expressed mRNAs or analyses of promoter/reporter constructs). Finally, this approach revealed new proteins associated with the different phases of seed germination and priming. Some of them are involved either in the imbibition process of the seeds (such as an actin isoform or a WD-40 repeat protein) or in the seed dehydration process (e.g. cytosolic glyceraldehyde-3-phosphate dehydrogenase). These facts highlight the power of proteomics to unravel specific features of complex developmental processes such as germination and to detect protein markers that can be used to characterize seed vigor of commercial seed lots and to develop and monitor priming treatments [1]. In a study, effects of different times of hydropriming on yield, yield components, phenological characteristics and percentage of protein of chickpea (*Cicer arietinum* L.) were examined in a randomized complete block design with three replicates in 2010. Seeds of chickpea were exposed at six different hydropriming times (2 h, 4 h, 6 h, 8 h, 10 h and control). The results of this experiment showed that the effect of hydropriming treatments for main branch and lateral branch number, number of pod per plant, biological yield, grain yield, time from planting to emergence, emergence to flowering, flowering to bloom and pod forming and growth length was significant. However, there was no significant difference between treatments in terms of plant height, number of seed per pod, number of empty pod, seed thousand weight, harvesting index, pod forming to seed pods and blooming to maturity, and percentage of seed protein [2]. Therefore, the objective of this study was to evaluate the nanoparticles effect on seedling vigour index in maize (*Zea mays* L.).

MATERIALS AND METHODS

In order to the nanoparticles effect on seedling vigour index in maize (*Zea mays* L.), this experiment was conducted in 2011 by a factorial design with four replications. The factor was included use of TiO_2 nanoparticle (0, 0.02, 0.03 and 0.04 percentage) and then in the laboratory at each Petri dish 100 seeds were placed between two layers of paper culture and Petri dishes were placed in Germinator for 8 days at 20 to 21C. After 8 days, 10 seedlings were selected and was determined seedling length and then placed on electrical Owen for 48h at 75ºC and determined seedling weight by electrical scale. Finally, germination percentage determined for caraway by following formula:

(Number of Seeds Germinated / Total Number of Seeds on Petri Dish) * 100

Data were subjected to analysis of variance (ANOVA) using Statistical Analysis System [SAS, 1988] and followed by Duncan's multiple range tests. Terms were considered significant at $P < 0.05$.

RESULTS AND DISCUSSION

The results showed that the effect of nanoparticle was significant on germination percentage, seedling vigour, seedling length and seedling dry weight in maize. Means comparisons showed that the highest germination percentage, seedling vigour, seedling length and seedling dry weight were achieved under use of 0.03 percentage TiO_2 nanoparticle.

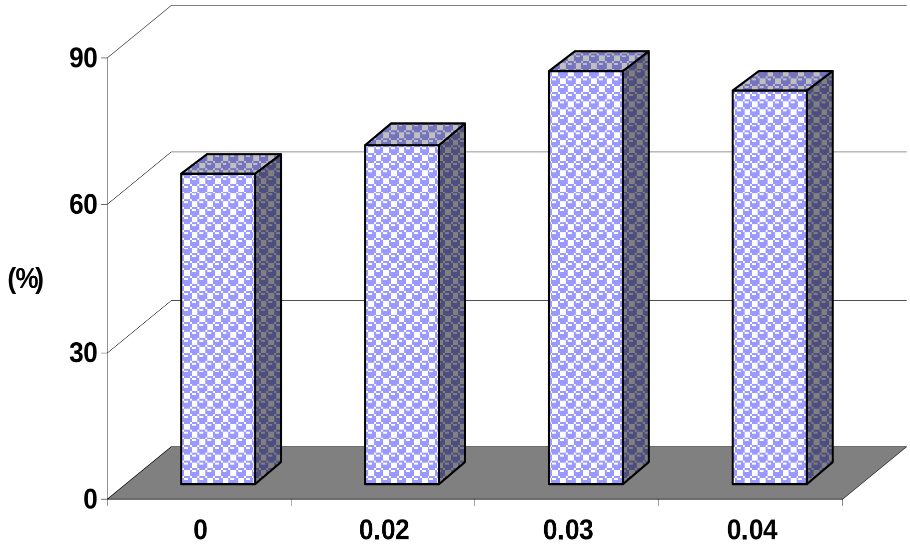

Fig. 1: Germination percentage in maize under nanoparticle application

The results showed that use of nanoparticles can increased seedling vigour index in maize that can increase energy efficiency management (EEM) for achieved to the sustainable agriculture. A smoke-derived butenolide, 3-methyl-2*H*-furo[2,3-*c*]pyran-2-one, has previously been shown to improve seedling vigour. The aim of this study is to examine the effect of hydropriming and butenolide priming treatments on seedling emergence and growth under different sowing depths at 20 and 25°C in two melon (*Cucumis melo* L.) seed lots of high and low quality. Seeds are subjected to hydropriming (21 h at 25°C) and butenolide priming (10^{-7} M, 21 h at 25°C) and sown at a depth of 4 or 8 cm in peat moss (field capacity, 64% water by mass). In general, seedlings from butenolide-primed and hydroprimed seeds are superior to those of the control. At 20°C, the effect of butenolide priming is more pronounced than that of hydropriming and the control, particularly for the seeds sown at a depth of 8 cm. Butenolide priming has a 'repair-inducing' effect and enhances the low-quality seeds more than those of the high-quality seed lot, an effect which is more obvious at 20°C than 25°C. It can be concluded that butenolide priming may be a useful tool to enhance melon seedling performance under low temperature sowing conditions [3]. Seed storability depends on factors such as variety, seed history, harvesting, drying and storage conditions, etc. Moreover, seed priming has been reported to both increase and decrease seed storability in many crops. Seed priming is a technique to hydrate seed in different ways to a moisture level sufficient to initiate the early germination process but not sufficient to permit radicle protrusion. Methods of seed priming can be divided into two groups depending on whether water uptake is uncontrolled (hydro-priming) or controlled (osmotic-priming and solid matrix priming). The benefits of seed priming are not only to extend seed storability but also to improve seed germination, seed vigor, uniform field emergence, and yield. However, the success of seed priming may vary due to variety, seed quality, seed lot, chemicals used, priming duration and temperature, and storage conditions. This experiment aimed to investigate the effect of delayed seed drying, duration of seed hydro-priming, and their interaction on rice seed storability at three different seed ages [4].

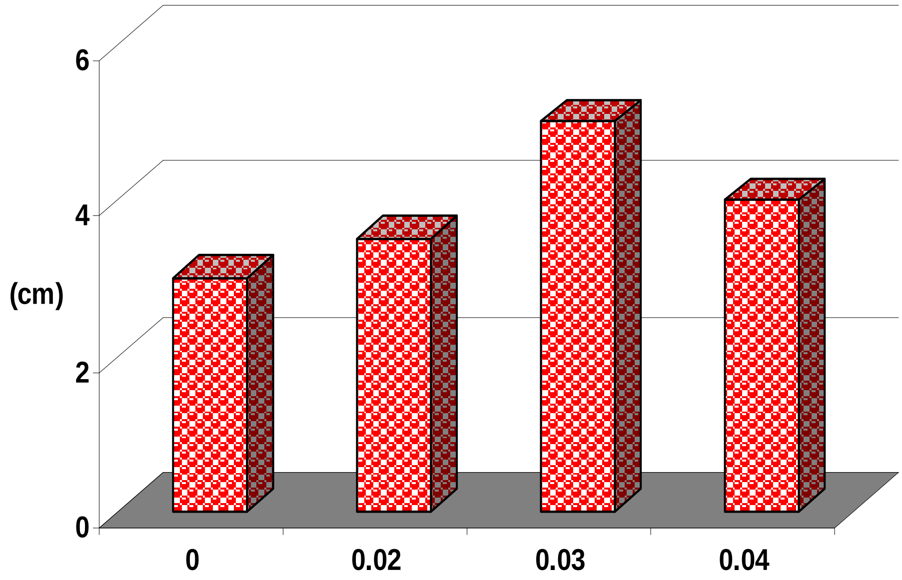

Fig. 2: Seedling length in maize under nanoparticle application

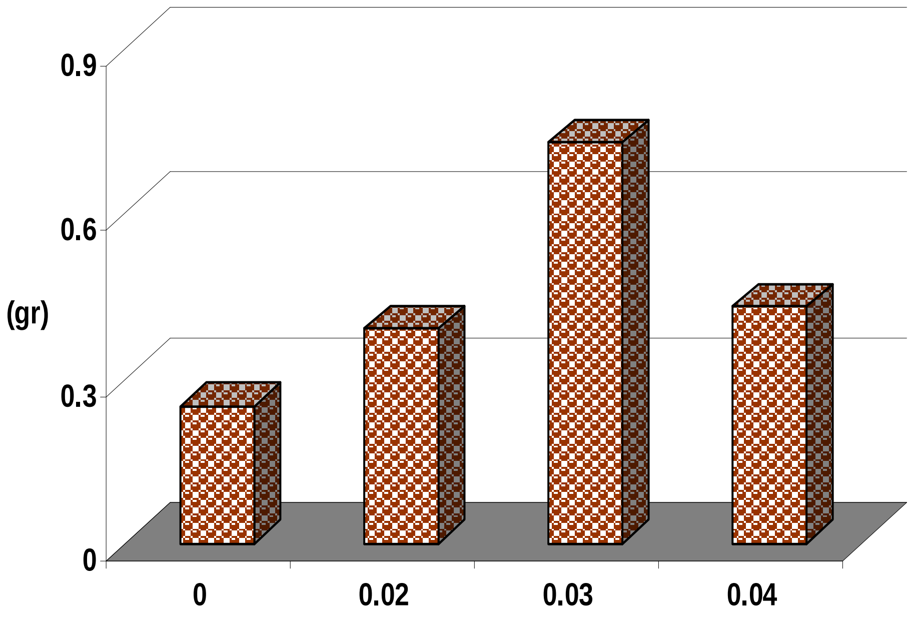

Fig. 3: Seedling weight in maize under nanoparticle application

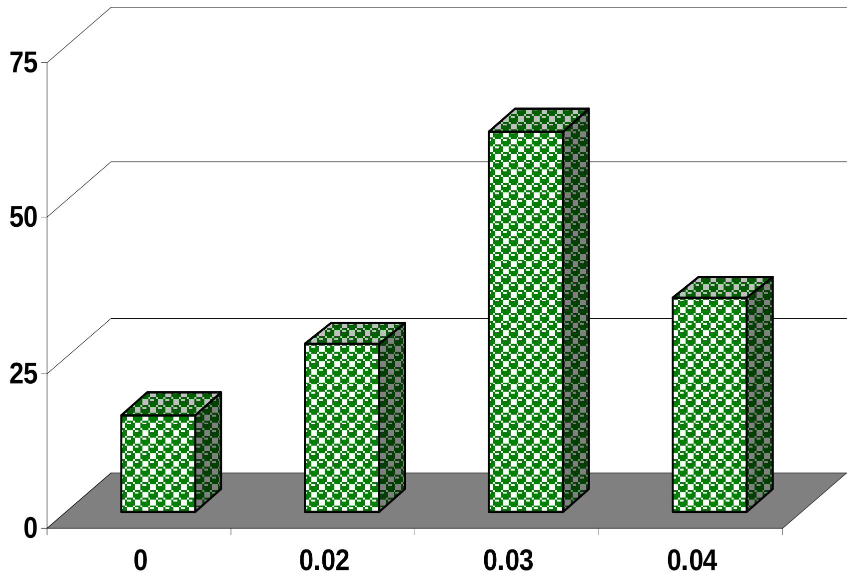

Fig. 4: Seedling vigour in maize under nanoparticle application

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