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The Effect Of different Concentrations Ofhumic Acidonseed Germination Behavior and Vigor of barley

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Abstract: To identify the effect of humic acid on the seed germination andearly seedling growth of barley, an experiment was conducted at the Biotech Research Center of the University of Zabol, Zabol, I.R. Iran. The experimental design for this study was a split–plot randomized design with four replicates. Main plot treatments werefivedifferentconcentrations ofacid humic (0, 250, 500, 750 and 1000 mg l-1) and subplot treatments consisted five priming duration (0, 6, 12, 18 and 24 h). Statistically significant differences were found to exist between interaction of different concentration of humic acid and priming duration on seedlingdry weight, seedling vigor index, dynamic weight of seed reserves and efficientuse of resources. The greatest seedling growth parameters was observed in seeds primed at concentration of 750 mg l-1 for 12 h. Increasing priming duration up to 12 h, increased and then decreasedthe parameters. In addition to, concentrationincreasing up to 500 and 750 mgL-1had the most effective impact on seedlinggrowth parameters. In conclusion, seed priming with humic acid through theinfluenceof heterotrophic growth can produce stronger seedlings.

Keywords: Seed priming, humic acid, seed vigor, barley.

INTRODUCTION

Seed priming is nowadays being extensively used to improve seed germination and seedling emergence in a wide range of crop species (Parera and Cantliffe, 1994) and is basically a physiological process in which the seeds are presoaked before planting which, by itself, allows partial imbibition though preventing the germination (Nascimento and Aragão, 2004). During the priming, several processes including storage, material handling, activation and synthesis of a number of enzymes and nucleic acids, repair and build up, ATP synthesis, and the cytoplasmic membrane repair in treated seeds will all start to develop (Parera and Cantliffe, 1994).

Humic acid is a principal component of humic substances, which are the major organic constituents of soil (humus), peat and coal. It is produced by biodegradation of dead organic matter. It is not a single acid; rather, it is a complex mixture of many different acids containing carboxyl and phenolate groups so that the mixture behaves functionally as a dibasic acid or, occasionally, as a tribasic acid (Akinci, *et al*., 2009; Canellas, *et al*., 2002).

Humic acid (HA), a decomposition product of organic matter, are characterized as a heterogeneous natural resource, ranging in colour from yellow to black, having high molecular weight, and resistance to decay. Humic acid, as a commercial product contains 44-58% C, 42-46% O, 6-8% H and 0.5-4% N, as well as many other elements (Larcher, 2003; Lee and Bartlett, 1976). It improves soil fertility and increases the availability of nutrient elements by holding them on mineral surfaces. The humic substances are mostly used to remove or decrease the negative effects of chemical fertilizers from the soil and have a major effect on plant growth, as shown by many scientists (Ghabbour and Davies, 2001). The auxin like activity of these humic substances in plants influences the cell division and cell elongation (Mato, *et al*., 1971; Schnitzer and Weightman, 1974).

Research conducted using humic acid on seed germination, seedling vigor, yield and quality etc, has proved that humic acid is a miracles organic crop energizer (Lulakis and Petsas, 1995; Malik and Azam, 1985). Humic substances are known to stimulate the germinationof several varieties of agricultural seeds (Lulakis and Petsas, 1995; Malik and Azam, 1985, David, *et al*., 1994; Dursun, *et al*., 1999). The immersion ofseeds in a sodium humate solution was reported to increasegermination, water absorption, and respiration(David *et al*., 1994), the length of roots and shoots (Rauthanand Schnitzer, 1981; Malik and Azam, 1985) and the freshand dry mass of roots and shoots (Lulakis and Petsas). The aim of the present study was to evaluate the effects of incubationperiodon seed germination and seedling growth of treating barley seeds with different concentration of humic acid.

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MATERIALS AND METHODS

The experiment was carried out in June 2011 at the Biotech Research Center of the University of Zabol, Zabol, I.R. Iran. Seeds of barley (*Hordeum vulgaris*) were obtained locally, and before being used for bioassays, their germination potentials was examined at 25 ± 1°C in darkness and germination over 95% also guaranteed the viability of the seeds (Asgharipour and Armin, 2010). The seeds were sterilized with 10:1 water/bleach (commercial NaOCl) solution for 5 minutes and subsequently washed with diluted water.

The seeds were then soaked in increasing concentrations (0, 250, 500, 750 and 1000 mg L-1) of humic acid at fourdifferentduration (6, 12, 18 and 24 h). The experiment was laid out as a split-plot design with humic concentration as the main plot and four duration of soaking as the sub-plot, together with four replicates. Twenty-five seeds were then germinated in sterilized Petri dishes, 100mm in diameter, on Whatmann filter-papermoistened with 10 mL of double-distilledwater. Petri disheswere subsequently kept in the dark, at 25 °C, for aspan of 7 days. The solutions were renewed after 3days. After 7 days, 10 seedlings of each petri weresampled with an aim to measure the root length andshoot height using a ruler (against a blackbackground). Dry weight was also evaluated afterdrying the specimens (10 seeds) for 72 hours at 76 °C. During the experiment, germinated seeds werecounted on a daily. Seed viabilitywas assessedby the final cumulative percentage of germination atthe end of the tests. Here, germination was considered only when the radicles were longer than2 mm. Seedling Vigor Index (SVI) was calculatedbased on (Soltani, *et al*., 2006):

SVI= (plumule length + radicle length) × seed viability

The dynamic reserve of seeds was obtained by subtracting the initial dry seed weight and seedresidue(Parera and Cantliffe, 1994). The ratio of normal seedlingdryw eight to the weight of the dynamic storage was considered as theofseed storage use efficiency.

The experiments were repeated twice and the pooled mean values were separated on the basis of Duncan Multiple Range Test (DMRT) at a probability level of 0.01.

RESULTS AND DISCUSSION

Two-way ANOVA exhibited that interaction effects of humic acid concentration and soaking duration was significant on seedlingdryweight, seedling vigor index, dynamicreserveofseeds and seed storage use efficiency. No statistically significant differences have been found to exist between the different concentrations and soaking period of humic acid on final germination percentage. Seedling dry weight significantly changed between different treatments (Fig. 1). Soaking of seeds in concentration of 750 mg l-1 of humic acid for 12 h exhibited the greatest seedling dry weight, while priming seeds at concentration of 750 mg l of humic acid for 0 h had the least dry weight of seedlings. (Atiyeh, *et al*., 2002) reported thatdifferent humic substances can bepositively affect the growth of tomato seedlings grown in different environments.

Different humic acid concentrations and duration had different effects ons eedling vigor index. Trend of seedling vigor index across different treatments revealed that the greatest seedling vigor index in seeds occurred whenseeds primed with concentrations of 500 and 750 mg l^{-1} of humic acid for 12 h (withvalues of 2370 and 2207, respectively), while in seed priming with control (non-application of humic acid) caused the highest radicle length.

The effectof seed priming on germination indicated that germination increased in primed seeds due to some metabolic and biochemical changes during priming. For examplee, in theseeds partof the protein and carbohydrate sarebrokendue to enzyme activity and the hydrolysisreaction. This process resulted in rapid germination and hence seedling emergence can be improved (Andoh, and Kobata, 2002).

Increasing concentration of humic acid and duration of priming significantly increased dynamic reserve of seeds. This is indicating better transport of storage materials of seed to vegetativeorgans.

Priming with concentration of 250 mg l-1 humic acid for 12 h and exhibited the greatest dynamic reserve of seeds (5.11 mg seed-1), while priming of seeds without humic acid for 0 h had the least dynamic reserve of seeds (Fig. 3).

Such positive effects of humic acid onplant growth is a concentration-dependence phenomenon and may be due tohormone-like activity of humic acid on cellularrespiration, photosynthesis, membraneperme ability of rootcells, protein synthesisand various enzymati creactions (Canellas, *et al*., 2002). The experiment revealed that different concentration levels of humic acid and duration of priming had asignificant effectonseed storage use efficiency.

The greatest storage use efficiency of seeds was observed in primed seeds in concentration of 750 mg l-1 of humic acid for 12 h (Table 2). Priming of seeds with concentration of 1000 mg l-1 for 0 h had the loweststorage use efficiency.

Over all results showed that application of humic acid has a positive effecton germination and early seedling growth of barley seeds. Such beneficial effects depend on both the concentration levels of humic acid and duration of priming. The positive effects of different solutions of humic acid on germination and growth of seedlings can be due to better water absorption and transport of the stored materials to the root and shoot growt has well ashormone-like activity of this substance. Therefore, humic acid applications increase the successful establishment of plants and ensure maximum performance under the environmental conditions.

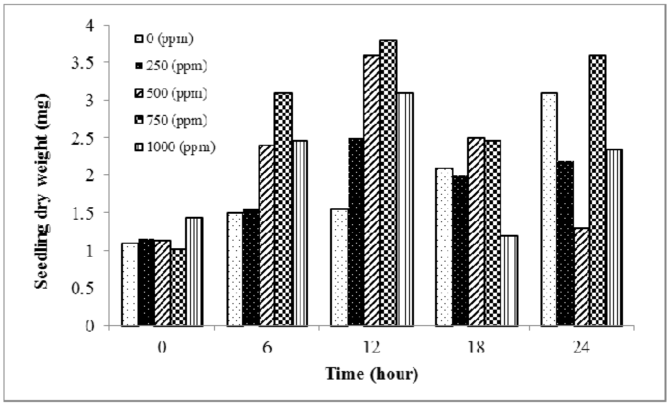

Fig. 1: Influence of various concentrations of humic acid and duration of priming on seedling dry weight (mg) ofbarley.

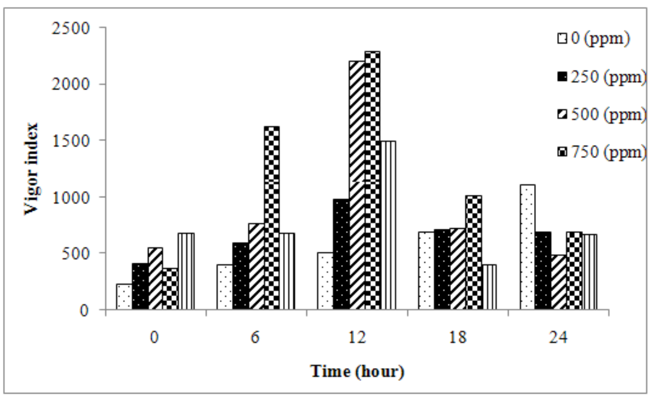

Fig. 2: Influence of various concentrations of humic acid and duration of priming on vigor index of barley seedlings.

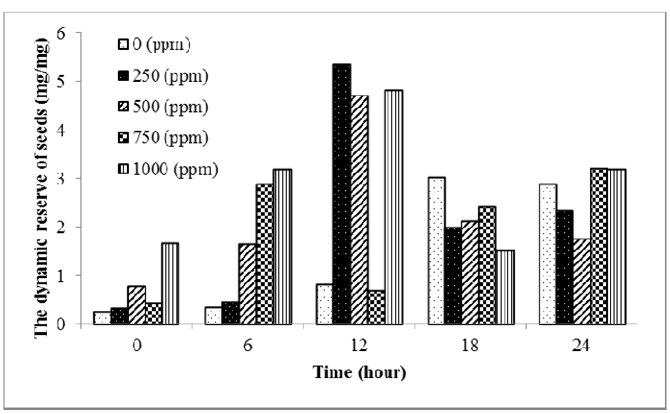

Fig. 3: Influence of various concentrations of humic acid and duration of priming on dynamic reserve of seeds of barley.

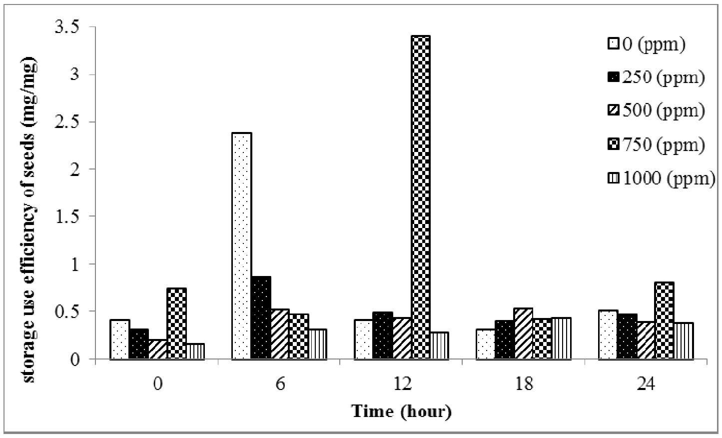

Fig. 4: Influence of various concentrations of humic acid and duration of priming on storage use efficiency ofseeds of barley.

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