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Journal of Nanostructure in Chemistry 2 (2) (2011) 162-161 Contents list available at JNSC Journal of Nanostructure in Chemistry (JNSC) I.A.U. journal homepage: www.jnsc.ir The Use of Titanium Dioxide Nanoparticles for Improve to Germination in Vigna sinensis L. 1 2 1 Hossein Aliabadi Farahani , Payam Moaveni and Kasra Maroufi

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ARTICLE INFO Article history: Received 10 November 2010 Accepted 7 February 2011 Keywords: Nanopriming, germination, seedling vigour, seedling growth and cowpea. ABS T R A C T Nanopriming

is a new method for increasing **of** 7

seedling vigour and

improvement of germination percentage and seedling growth in crops. In order to 10

determine the impact of nanopriming on germination of cowpea seeds, an experiment was conducted at

Islamic Azad University, Shahr-e-Qods Branch, Tehran, Iran 9

in 2011 by a completely randomized design with three replications. The factor studied included different spraying in three levels of Tio2 (control, 0.01 and 0.02 percentage) through the placing seeds were exposed to oven. The results showed that the effect of nanopriming was significant on germination percentage, seedling dry weight, seedling vigour and seedling length in $P \leq 0.01$. Mean comparison showed that the highest germination percentage (90 %), seedling dry weight (2.05 gr), seedling vigour (184.5) and seedling length (8.58 cm) were achieved by spry of 0.01% Tio2. Finally, nanopriming treatment can be successfully applied on cowpea seeds to improve germination performance. 1. Introduction Seed priming is a presowing seed treatment that improves seed performance by increasing germi- nation rate and uniformity. Priming exposes seeds to imbibition in low external water potentials that allows seed partial hydration [4]. Seed priming may also increase the seed or seedling tolerance Email: A.R.Abbaspourrad@shahryariau.ac.ir to stress. Priming initiates metabolic activities, such as protein, RNA, and DNA synthesis, DNA replication, and b-tubulin accumulation [17]. . Recently, it has been suggested that priming could enhance the activity of antioxidative systems, resulting in lower rate of lipid peroxidation, contri- buting to seed invigoration [2], Wang et al., 2003). When seed is allowed to imbibe, the rapidly increa- sing respiratory activities elevate free radical production, resulting in oxidative stress to cellular components [17] [3]. Priming is responsible to 163 H. Aliabadi Farahani et al. / Journal of Nanostructure in Chemistry 2 (2) (2011) repair the age related cellular and sub cellular damage of low vigour seeds that may accumulate during seed development [5]. Priming of seed promotes germination by repair of the damaged proteins, RNA and DNA [15].

The conditions during seed priming and during subsequent germination and emergence were investigated as potential causes of variable seedling emergence relative to that of untreated seeds. 5

A particle in which at least one of the dimensions does not exceed 8

100 nm is classified as a nanoparticle. Nanoparticles are characterized by high ratio of surface area to volume or weight, what strongly influences physical and chemical properties of nanosized materials [1]. Nanoproducts find appli- cations

in many fields of daily life. Many products, e.g. 8

fillers, opacifiers, catalysts, pharmaceuticals, lubricants or cosmetics are based on the nanoparticles [19]. The increasing implementation of nanotech- nologies brings a growing risk of creating a new generation of waste -nanowaste [6].

However, in recent times, nanoparticles have drawn the attention of scientists and engineers because of their extensive application in the development of new technologies such as the chemical industry, electronics, catalysis, and biotechnology at the nanoscale 3

[24]. In nano- technology,

submicroscopic particles ranging from 1 to 100 nm in diameter are usually referred to as nanoparticles. In recent years there has been a great deal of development of nanoparticles of different size, chemical nature and structure. 4

TiO_2 has been widely investigated for its promising applications in the field of catalysis [13] [14] [24]. Numerous efforts have been focused on the improvement of its catalytic capability for the destruction of organic and inorganic pollutants that exist in air and aqueous systems. Within the fast growing area of photoche- mistry of nanosemiconductor materials, particularly in the last decade, TiO_2 nanoparticles became the focus of interest due to their unique photophysical and photocatalytic properties compared with that of the bulk.

This study was conducted to examine the Influence of nanopriming on germination of 7 cowpea (Vigna sinensis L.) seed's. 2. Materials and

Methods In order to determine the effect of 7

nanopriming on germination in cowpea seed's, an experiment was conducted in 2011 at Laboratory

Sciences, Islamic Azad University Shahr-e-Qods Branch 14

by a completely randomized design with three replica- tions and the first, seed viability was determined by Tetrazolium test method. The factor studied included different spraying in three levels of Tio2 (control, 0.01 and 0.02 percentage) through the placing seeds were exposed to oven. After disinfec- ting, seeds were put in disinfected Petri dish. Each Petri dish contained 100 seeds. Three

replicates of 100 seeds were put between double layered rolled. The rolled paper with seeds was put into sealed plastic bags to avoid moisture loss. 6

All of the Petri dish irrigated by distilled water.

Seeds were allowed °C to germinate at 25 ± 1 13

for 8 days. Germination percentage was recorded after the 8th day. Germi- nation percentage was calculated with the following formula: Germination percentage = Number of germinated seeds / Number of total seeds × 100 Also, Seedling vigour index was calculated by the following formula: Seedling vigour index = Germination percentage × Seedling dry weight H. Aliabadi Farahani et al. / Journal of Nanostructure in Chemistry 2 (2) (2011) 164 Data analyses were performed using the Spss statistical software (Version 16). Mean separations were performed by Duncan's multiple range test (DMRT) at 5% level. 3. Results and Discussions The results showed that the effect of nanopriming was significant on germination in $P \leq 0.01$. The highest germination percentage, seedling dry weight, seedling vigour and seedling length were achieved by spry of 0.01% Tio2 (Table1, Fig1, 2, 3 and 4) and lowest germination percentage, seedling dry weight, seedling vigour and seedling length were achieved by spry of 0.02% Tio2 (Table1, Fig1, 2, 3 and 4). Priming enhanced germination, better establishment and increased yields in a range of crops in many diverse environments [21].The priming 11

technique due to its simplicity might be acceptable to the farmer of area as accepted to farmer in other semi arid region and promoted to a wide range of crops, for example maize [9], wheat [10], mung bean [20], Chick pea [18], upland rice in India [11] and millet in India [16].

It has been long known that one of the main merits of priming treatments is to increase germination and emergence rate 2

[12].

However, the question arises whether rapid radicle protrusion is always reflected in rapid seedling emergence. 2

[8]

Proposed that emergence losses in the soil are not generally due to germination failure, but failure of seedlings to grow and emerge above soil surface. 2

[22] who observed earlier germination of primed Jalapeno pepper seeds. Increased emergence rate due to seed priming may be due to

increased rate of cell division in the root tips of 10

seedlings from primed seeds as reported in tomato [7]. Increased shoot and root length may be due to early emergence induced by priming treatment as compared to un-primed seeds. [23] presented the same results by observing that priming of the pepper seeds significantly improved root length.

Nanocrystals generally display properties different from the bulk material or the atomic or molecular species from which they are derived. A key to the study of their size-dependent properties is the availability of samples of high quality, internally crystalline nanoparticles. For significant physical measurements to be made, these samples must be macroscopic, and therefore a distribution in particle sizes is inevitable. This distribution ought to be as narrow as possible, and the position of its peak as controllable as possible. 1

TiO2 nanoparticles are of particular interest inasmuch as they have been widely used in important technological applications. 1

Nanopriming (%) 0 0.01 0.02 (%) 100 80 60 40 20 0 Table1: Means Comparison Germination percentage (%) 69 b 91 a 56 c b Seedling dry weight (g) 1.74 b 2. 5 a 1.1 c a Seedling vigour 124 b 183 a 64 c 0 0.01 0.02 TiO2 c Seedling length (cm) 7.44 b 8.56 a 5.48 c Figure 1: Effect of nanopriming on germination percentage in cowpea 165 H. Aliabadi Farahani et al. / Journal of Nanostructure in Chemistry 2 (2) (2011) Reference (g) 2.5 2 1.5 1 0.5 0 b 0 0.01 0.02 a TiO2 Figure 2: Effect of nanopriming on seedling dry weigh in cowpea 200 160 120 80 40 0 b 0 0.01 0.02 a TiO2 Figure 3: Effect of nanopriming on seedling vigour in cowpea cmm 10 8 6 4 2 0 b 0 0.01 0.02 a TiO2 Figure 4: Effect of nanopriming on seedling length in cowpea c c c [1] Aitken RJ, Creely KS, Tran CL (2004). Nanopar- ticles: An Occupational Hygiene Review. Health and Safety Executive, Suffolk, UK. [2] Bailly C, Benamar A, Corbineau F, Come D (2000). Antioxidant systems in sunflower (Helianthus annuus L.) seeds as affected by priming. Seed Sci. Res. 10: 35-42. [3] Bailly C (2004). Active oxygen species and anti- oxidants in seed biology. Seed Sci. Res. 14: 93-107. [4] Bradford KJ (1986). Manipulation of seed water relations via osmotic priming to improve germination under stress conditions. HortScience, 21, 1005-1112. [5] Bray CM (1995). Biochemical processes during osmopriming of seeds. In: Kigel, J. and G. Galili (eds.), Seed Development and Germination, pp: 767- 789. New York, Basel, Hong Kong, Maceldekker. [6] Bystrzejewska-Piotrowska G, Golimowski J, Urban L (2009). Nanoparticles: Their potential toxicity, waste and environmental management. Waste Manag. 29(9): 2587-2595. [7] Farooq M, Basra SAM, Hafeez K, Ahmad N (2005). Thermal hardening: a new seed vigour enhancement tool in rice. Journal of Integretive Plant Biology 47: 187-193. [8] Halmer P, Bewley JD (1984). A physiological pers- pective on seed vigour testing. Seed Sci. Technol. 12, 561–575. [9] Harris D, Rashid A, Miraj G, Arif M, Shah H (2007). On-farm seed priming with zinc sulphate solution- A cost-effective way to increase the maize yields of resourcepoor farmers. Field Crops Res., 102: 119-127. [10] Harris D, Pathan AK, Gothkar P, Joshi A, Chivasa W, Nyamudeza P (2001). On-farm seed priming: using participatory methods to review and refine a key technology. Agric. Syst., 69: 151-164. [11] Harris D, Tripathi RS, Joshi A (2002). On-farm seed priming to improve crop establishment and H. Aliabadi Farahani et al. / Journal of Nanostructure in Chemistry 2 (2) (2011) 166 yield in dry direct-seeded rice, in IRRI: International Workshop on Dry-seeded Rice Technolgoy; held in Bangkok, 25-28 January 2008. The International Rice Research Institute, Manila, the Philippines, pp. 164. [12] Heydecker W, Coolbear P (1977). Seed treatments for improved performance survey and attempted prognosis, Seed Sci. Technol., 5, 353–375. [13] Hoffmann MR, Martin ST, Choi W, Bahnemann DW (1995). Chem. Rev. 95, 69. [14] Howe RF (1998). Dev. Chem. Eng. Miner, Process. 6, 55. [15] Koehler KH, Voigt B, Spittler H, Schelenz M (1997). Biochemical events after priming and priming of seeds In: Ellis, R.H., M. Black, A. J. Murdoch and T.D. Hong (eds.), Basic and Applied Aspects of seed Biology, Proc. 5th Int. Workshop on Seeds Reading, pp: 531–536. [16] Kumar A, Gangwar JS, Prasad SC, Harris D (2002). On-farm seed priming increases yield of direct-sown finger millet (Eleusine coracana) in India. Int. Sorghum Millets Newsletter, 43: 90-92. [17] McDonald MB (2000). Seed priming, pp.287- 325. In M. Black, and J.D. Bewley (eds.). Seed Techno- logy and Its Biological Basis. Sheffield Academic Press, Sheffield. [18] Musa AM, Harris D, Johansen C, Kumar J (2001). Short duration chickpea to replace fallow after aman rice: the role of on-farm seed priming in the High Barind Tract of Bangladesh. Exp. Agric., 37: 509- 521. [19] Nel A, Xia T, Madler L, Li N (2006). Toxic Potential of Materials at the Nanolevel Science 311:622-627. [20] Rashid A, Harris D, Hollington PA, Raffiq M (2004). Improving the yield of mung bean (Vigna radiata) in the North West frontier province of Pakistan using on-farm seed priming. J. Expt. Agric., 40: 233-244. [21] Rashid A, Hollington PA, Harris D, Khan P (2006). On-farm seed priming for barley on normal, saline and saline-sodic soils in North West frontier province of Pakistan using on-farm seed priming. Europ. J. Agron., 24: 276-281. [22] Rivas M , Sundstorm FJ , Edwards RL (1984). Germination and crop development of hot pepper after seed priming. HortScience 19: 279-281. [23] Stofella PJ, Lipucci DP, Pardossi A , Toganoni F (1992). Seedling root morphology and shoot growth after seed priming or pre-emergence of bell pepper. Journal of the American Society for Horticultural Science 27: 214-215. [24] Tanaka K (1999). Thin Solid Film. 341 120.