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Effect of seed inoculation with bio-fertilizer on germination and early growth of corn

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Abstract

In order to study effect of seed inoculation with nitragin as bio-fertilizer at concentrations of 6, 7 and 8 cc and distilled water as control on germination and early growth of corn, a laboratory experiment was conducted in Islamic Azad University of Tabriz in completely randomized design with three replicates. The results revealed that in those corn seeds were inoculated with 6 cc nitragin, root length increased by 35%, compared with the control. Inoculation of corn seeds before planting with 6 cc nitragin gave rise in shoot length around 54%, compared with un-primed ones. In seeds treated with the same treatment seedling length increased up to 222mm, in comparison to check plots. When nitragin concentration reduced up to 8 cc, shoot dry weight increased nearly 17g. In 6 cc nitragin, root/shoot dry weight ratio increased by 2%, and due to primed seeds with 8cc nitragin improved 16%. In the highest nitragin concentration crop CGR increased by 43%, compared in comparison with control. Also, the lowest CGR occurred in seeds treated with distilled water. It was concluded that corn producers could improve germination and early growth of corn by seed priming with nitragin.

Keywords: Biofertilizers, Concentration, Corn, Germination, Nitragin.

Introduction

Good seed germination behavior is important for horticulture and agriculture. Uneven or poor germination and subsequently inhomogeneous seedling growth can lead to great financial losses, by e.g., reduced possibilities for mechanization, or lower prices of inhomogeneous plant batches (Ghiyasi *et al*., 2008 a) seed priming can increase speed and uniformity of germination (Ghiyasi *et al*., 2008 b). Seed priming treatments can lead to better germination and establishment in many crops such as maize, wheat, rice, canola (Basra et al., 2005; Ghiyasi *et al*., 2008 a, b). Seed priming treatments include non- controlled water uptake systems and controlled systems (Ashraf *et al*., 2003). Pre-sowing seed treatments (seed priming) include hydropriming, biopriming, seed soaking, hormonal-priming, and magneto-priming. More recently, a real challenge faces the workers in the agricultural research field to stop using the high rates of gro-chemicals which negatively affect human health and environment. It is well known that corn crop is considered among the most important cereal crops either in Egypt or all over the world that consumes huge quantities of chemical fertilizers. Many attempts have been tried to replace a part of those harmful chemical fertilizers by biofertilizers to get yield of a good quality without loss in its quantity. Mishra *et al* (1995) and El- Kholy and Gomaa (2000) have succeeded to reduce the recommended doses of chemical fertilizers needed for corn and millet by 50 % using biofertilizers without loss in the yield. Free-living nitrogen-fixing bacteria *eg Azotobacter chroococcum* and *Azospirillum lipoferum,* were found to have not only the ability to fix nitrogen but also the ability to release

phytohormones similar to gibberellic acid and indole acetic acid, which could stimulate plant growth, absorption of nutrients, and photosynthesis (Fayez *et al.,* 1985). *Azospirillum*, *Pseudomonas* and *Azotobacter* strains could affect seed germination and seedling growth (Shaukat et al ., 2006a). Kloepper et al (1992) has been shown that wheat yield increased up to 30% with *Azotobacter* inoculation and up to 43% with *Bacillus* inoculation. Strains of *Pseudomonas putida* and *Pseudomonas fluorescens* could increase root and shoot elongation in canola (Glick et al., 1997) as well as wheat and potato (de Freitas and Germida, 1992), (Frommel et al., 1993). Inoculation of plants with *Azospirillum* could result in significant changes in various growth parameters, such as increase in plant biomass, nutrient uptake, tissue N content, plant height, leaf size and root length of cereals (Bashan et al., 2004). Thus it has been shown that *Azospirillum* and *Pseudomonas* had the potential for agricultural exploitation and could use as natural fertilizers (Bashan et al., 1989), (Cakmakc et al., 2006). However, the effects of these bacteria on growth and yield of some crop plants studied in previous works. But the effects of PGPR on growth parameter from germination to yield were not evaluated simultaneously. The main objective of this research was to determine if PGPR strains could affects on seed germination, growth parameters of maize seedling in greenhouse and also grain yield of field grown maize. Bacterial inoculants are able to increase plant growth and germination rate, improve seedling emergence, responses to external stress factors and protect plants from disease (Lugtenberg et al., 2002). Similar improvement of seed germination parameters by rhizobacteria has been reported in other cereals such as sorghum (Raju et al., 1999) and pearl millet (Niranjan et al., 2004) and (Niranjan et al., 2003). These findings may be due to the increased synthesis of hormones like gibberellins, which would have triggered the activity of specific enzymes that promoted early germination, such as aamylase, which have brought an increase in availability of starch assimilation. Beside, significant increase in seedling vigor would have occurred by better synthesis of auxins (Bharathi et al., 2004).The main goal of the current trial is looking for the best biological treatments could be applied to the corn crop to get a high yield with a good quality in addition to keep our environment clean and safe to live in.

Materials and Methods

The experiment was conducted at biotechnology laboratory in Islamic Azad University of Tabriz in completely randomized design with three replicates, during 2006 growing season at Tabriz, Iran. This study consists of experiment on seed inoculation with nitragin as biological fertilizer at concentrations of 6, 7 and 8 cc and distilled water as control on germination and early growth of corn, a laboratory experiments was conducted in Islamic Azad University of Tabriz in completely randomized design with three replicates. The seeds were surface sterilized with 5% NaOCL (sodium hypo chloride) for 5 min to avoid fungal invasion, followed by washing with distilled water. The seeds were primed by solutions of nitragin. Nitragin involves free-living and associative bacteria such as *Azospirillum, Azotobacter* and *Pseudomonas.* For inoculation seeds were coated with 20% gum arabic as an adhesive and rolled into the suspension of bacteria (10^8 cfu ml^{-1}) until uniformly coated. Germination tests were conducted using 3 replicates of 50 seeds in 9 cm petri dishes. They were placed in a growth chamber where temperature was 20 ℃ for 10 days. Nitragin (Azotobactin) which is a water -soluble active fluid and contains nearly 10^8 viable cells number per each mL solution, was provided from Asia Zist Fanavari Company in Zanjan, Iran. Petri dishes and filter paper were dis-infected by sodium hypochloride and UV radiation for 24 hours in a sterile hood. In each petri dishes, 50 corn seeds were sown. In all treatments, seeds were mixed with a solution of starch and sugar-coated and then inoculated with nitragin concentrations. After bio-priming seeds were washed three times with distilled water then re-dried to near original weight under shade. In order to calculate the germination rate, from the second day of germination testing each day the number of germinated seeds were counted. In this experiment, germination was defined as at least 5 mm of radical emerged. Traits measured including, root length, shoot length, seedling length, root to shoot ratio, root dry weight, shoot dry weight, Seedling dry weight, root to shoot ratio of dry weight, germination percentage and Crop growth rate.

Root and shoot length of individual seedling was measured to determine the vigor index with following formula: Vigor index= (mean root length +mean shoot length) × % germination (Abdul Baki and Anderson, 1973). The statistical analysis was carried on the obtained data according, where the means compared using L.S.D. test at 0.05 level of significance. Analysis of variance by the software MSTAT-C and graphs were done with Excel software.

Results and Discussion

Seed Inoculation significantly enhanced seed germination and seedling vigour of maize.

Root length (Lr)

Among the different levels maximum root length was 173 mm by the placement seeds for 2 hours in solutions and the lowest plant height in the absence of priming equivalent to 112/3 mm. can be expressed is the lack of priming reduced the root length is 35/08 percent, so the positive effects can be realized seed priming. Kloepper et al (1992) has been shown that wheat yield increased up to 30% with *Azotobacter* inoculation and up to 43% with *Bacillus* inoculation. Strains of *Pseudomonas putida* and *Pseudomonas fluorescens* could increase root and shoot elongation in canola (Glick et al., 1997) as well as wheat and potato (deFreitas and Germida 1992), (Frommel et al., 1993).

Shoot length (Ls)

There are Significant differences among the nitragin different levels in the mean comparisons. According to table (1) is expressed such that the maximum shoot length equivalent to 57/90 mm by seed priming with nitragin 6 cc and the lowest shoot length was priming with water equal 26/20 mm, so the positive effects of nutrient can be seen 54 percent of shoot length.

Seedling length

Also application different levels priming had significant difference between levels. The highest seedling length, equal 222.6 with 6 cc nitragin and the lowest was equal (136 mm) without priming (Figure 1). Thus can express the positive effects of Prime 38/90% increase in seedling length. *Azospirillum*, *Pseudomonas* and *Azotobacter* strains could affect seed germination and seedling growth (Shaukat, et al .2006a)

Lr/Ls

The results of variance analysis showed that bio-priming of different seed priming showed significant difference at 5% level. Results of comparing different levels showed that priming had positive role in increasing lr/ls. The highest lr/ls was 4/32 mm without priming.

Vigor index

Seed Inoculation significantly enhanced seed germination and seedling vigour of maize. However, the rate of enhancement varied with bacterial strains. Increased seed germination up to 30/68 % over nontreated control. The highest enhancement of vigor indexes were obtained from 6CC Nitragin.The results of study showed that inoculation of maize seeds with nitragin increased by inoculation.

Root dry weight

There are Significant differences among the nitragin different levels in the mean comparisons. According to to table (1) is expressed such that the maximum root dry weight equivalent to 35 (g) by seed priming with 6cc nitragin and the lowest root dry weight was priming with 7cc nitragin equal 23/67 gr, so the positive effects of nitragin can be seen 25/71 percent of dry weight.

Shoot dry weight

The results of variance analysis showed that inoculation nitragin reduced the shoot dry weight was such that different levels of seed priming showed significant difference at 5% level. Results of comparing different showed that priming had positive role in increasing seed Shoot dry weight but the times of priming had not significantly different. The highest Shoot dry weight in corn seeds was equivalent 17/33 (8cc nitragin) and the lowest was 12 (7cc nitragin) that 30/75 % reduction shown (Figure 2).

Seedling dry weight

The results of variance analysis showed that inoculation nitragin reduced the Seedling dry weight was such that different levels of seed priming showed significant difference at 5% level. Results of comparing different showed that priming had positive role in increasing seed Seedling dry weight but the times of priming had not significantly different. The highest Seedling dry weight in corn seeds was equivalent 50/67 (6cc nitragin) and the lowest shoot length was priming with water equal 25/57 (7cc nitragin). *Azospirillum*, *Pseudomonas* and *Azotobacter* strains could affect seed germination and seedling growth (Shaukat et al., 2006a)

Root dry weight to shoot dry weight (Wr/ws)

There are Significant differences among the nitragin different levels in the mean comparisons. The maximum wr/ws equivalent to 2/41 g by seed priming with nitragin 6 cc and the lowest shoot length was priming with water equal 2/250.

Germination percent (gp)

The results of variance analysis showed that bio-priming of different seed priming showed significantdifference at 5% level. Results of comparing different levels showed that priming had positive role in increasing germination percent.The highest gp was 99 % without priming.

Crop growth rate (crg)

The results of variance analysis showed that biopriming of different seed priming showed significantdifference at 5% level. Results of comparing different levels showed that priming had positive role in increasing crop growth rate.The highest crop growth rate was 5/21 without priming.

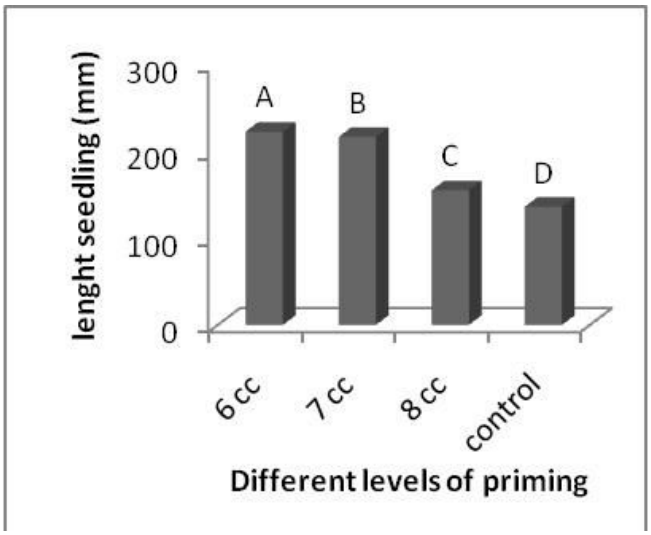

Figure 1. Different levels of priming effect on length seedling.

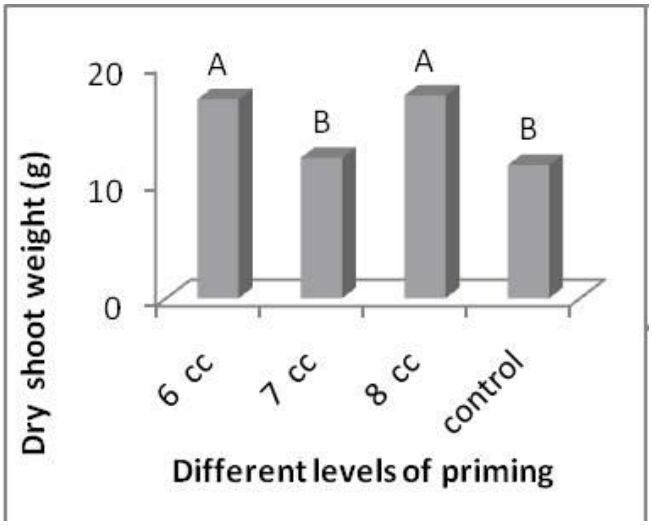

Figure 2. Different levels of priming effect on dry shoot weight.

Table 1. Analysis Variance of traits in corn

S.o.v	df	Root length (lr)	Shoot length (ls)	length Seedling	Lr/ls	Root weight (wr)	Shoot weight (ws)	Seedling weight	Wr/ws	Vigor index	Gp	crg
Treatment	3	2775/5	653/98	5667/69	2/04	93/86	30/12	375/42	0/018	23400282/08	103/5	5/53
Error	8	9/09	1/75	9/97	0/05	6/41	0/91	3/84	0/22	958077/8	1/50	0/06
C.V(%)		2/15	3/02	1/72	7/51	8/56	6/63	4/99	20/44	5/92	1/32	6/51

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