INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 3, No. 11, p. 108-114, 2013

RESEARCH PAPER OPEN ACCESS

Influence of seed inoculation with biological fertilizer on fennel (*Foeniculum Vulgare*) and coriander (*Coriandrum Sativum*) germination

Hossein Khoshvaghti[1], Mohammad Akrami[1], Mehri Yusefi[1], Sahar Baserkouchehbagh[2*], Marziyeh Hoseini[3]

[1]*Department of Agriculture, Payame Noor University, PO BOX 19395-3697, Tehran, Iran*

[2]*Young Researchers And Elite Club, Tabriz Branch, Islamic Azad University، Tabriz, Iran*

[3]*Department of Agronomy and Plant Breeding,Tabriz Branch, Islamic Azad University, Tabriz, Iran*

Key words: Bio-fertilizer, fennel, coriander, seed germination, priming.

doi: http://dx.doi.org/10.12692/ijb/3.11.108-114 Article published on November 17, 2013

Abstract

In order to study effects of seed inoculation with Nitragin as bio-fertilizer at concentrations of 2, 3 and 4 cc (ml) and distilled water as control on seed germination and early growth of fennel, a laboratory experiment was conducted in Islamic Azad University of Tabriz in completely randomized design (CRD) with three replications. Results showed that fennel seeds were inoculated with 4 cc (ml) Nitragin, root length increased by 6.5%, compared with the control. Inoculation of fennel seeds with 4 cc (ml) Nitragin was increased shoot length around 3%, compared with un-primed. Seeds which treated with the same treatment seedling length increased up to 179 mm, and root/shoot ratio increased 3.8%, in comparison to control plots. When Nitragin concentration reduced up to 3 cc (ml), shoot dry weight increased nearly 1.4g. In concentration of 2 cc (ml) Nitragin, root/shoot dry weight ratio increased by 45%. In the highest nitragin concentration GR increased by 43%, compared to control. Also, the lowest GR was occurred in seeds treated with distilled water. It was concluded that fennel producers could improve germination and early growth of fennel by seed priming with nitragin.

* **Corresponding Author:** Sahar Baserkouchehbagh ✉ sahar_baser@yahoo.com

Introduction

Fennel (*Foeniculum vulgare* Mill.; Fam. *Umbelliferae*) is one of the most important medicinal and aromatic plants due to its estrogenic activities and uses as a carminative, diuretic, anti-inflammatory, antimicrobial, and galactogogue. It is a substance which is used to increase the production of milk in humans and other animals. In addition, the volatile oils of fennel are used to control flatulent dyspepsia and colic in children (Mahfouz and Sharaf-Eldin, 2007). Using bio-fertilizers that contain different microbial strains has led to a decrease in the use of chemical fertilizers and has provided high quality products free of harmful agrochemicals for human safety (Mahfouz and Sharaf-Eldin, 2007). One of the methods that reduce fertilizer usage is seed pre-planting treatments called priming that include water absorption at enough level to begin germination events that is accomplished by the subsequent drying. The purpose of priming is increasing germination percent, decreasing mean of germination time and improving growth and vigor of seedling at very wide favor and un-favored environmental conditions. This method is successful in small seed plants and the most medicinal plants that have great economic value with quick and uniform emergence requirement (Ellis and Roberts, 1981). These techniques include hydro priming and hormonal priming or soaking prior to sowing (Basra *et al.,* 2005; Ashraf and Foolad, 2005). Seed priming techniques are used to reduces emergence time, accomplish uniform emergence, better allometric (changes in growth of plant parts over time in many horticultural and field crops (Ashraf and Foolad, 2005; Farooq *et al.*, 2005). Badran and Safwat (2004) and El-Ghadban *et al.* (2006) found that fennel responded to bio-fertilizer by increasing growth and oil yield and changing the chemical composition. Yousry *et al.* (2003) indicated that inoculation of pea (*Pisum sativum*) plants with *Bacillus megatherium* increased plant dry matter by 10.9%, while the combined application of *B. megatherium* and P-fertilizer increased 19.7% of dry matter by Amin (1997), on coriander (*Coriandrum sativum*), fennel (*Feoniculum vulgare*), and caraway (*Carum carvi*), showed that the growth was influenced by seed inoculation (*Azotobacter* and *Azospirillum*) with a half dose of inorganic fertilizer. In this condition plant growth was equal to full dose of inorganic fertilizer. Tehlan *et al.* (2004) reported that plant growth and seed yield of fennel varied according to the *Azotobacter* applied. These results are in agreement with research results of Gad (2001) for fennel (*Foeniculum vulgare*) and dill (*Anethum graveolens*), who reported that biofertilizers on these plants increased growth and yield. Viable seed is capable of producing new plant under both favorable and unfavorable climatic conditions. High number of seed emergence cause vigorous seedling and better stand establishment (Baleševi-Tubi and colleagues., 2007). Excessive use of fertilizers in order to achieve higher yields and food shortages can increase production costs and degradation of water resources and soil healthy and sustainable farming systems in terms of ecological interest is to specialists (Tilak *et al.*, 1992). Kennedy and Tychan (1997) indicated that germination of corn seed accelerated by inoculated with *Azotobacter*. Inoculation of plants with *Azospirillum* was caused a 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). In recent years, a lot of work has been done on the invigoration of seeds to improve the germination rate and uniformity of growth and reduce the emergence time of many vegetables and some field crops (Basra *et al.,* 2003; Tehlan *et al.,* 2004). The aim of the present study was to evaluate the effects of seed inoculation with biological fertilizer (Nitragin) on germination and early growth of fennel (*Foeniculum vulgare*) and study effects of Nitragin in agriculture in order to achieve the goals of sustainable agriculture.

Material and methods

Laboratory experiment

The laboratory experiment was done by complete randomized design (CRD) with three replications was

conducted in Islamic Azad University of Tabriz, Iran. This study was assessment of seed inoculation with Nitragin as biological fertilizer in concentrations of 2, 3 and 4 cc (ml) and distilled water as control on seed germination and early growth of fennel (*Foeniculum vulgare*). 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 which involves free-living and associative bacteria such as *Azospirillum, Azotobacter* and *Pseudomonas*. Germination tests were conducted by using 3 replicates of 50 seeds in petri dishes (dimention of petri dishes are 9 cm). There are 10^8 viable bacterial cells on 1 ml fluid of Nitragin (Azotobactin) active water-soluble (Okon, 2002). Petri dishes and filter paper after disinfection with sodium hypo chloride, and also in order to ensure the absence of any contamination were in UV radiation for 24 hours under a sterile electric hood. For each treatment 50 seeds with three replications incubated in growth chamber at 28°C. After 7 days the number of germinated seeds was counted. In each petri dishes, 50 fennel healthy seeds was considered. In all treatments, seeds were disinfected with a solution of starch and sugar-coated, then inoculated with Nitragin treatments. Petri dishes in plastic bags were transferred inside the container grown 25±1 °C. In order to calculate the germination rate, Petri dishes containers from the second day of testing each day until the tenth day of out-grown and the number of germinated seeds were counted. In daily counting if necessary, distilled water was added to the wet filter paper. 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.

The germination rate (GR) was calculated by using the equation below (Maguirw, 1962).

$GR = \Sigma n / N \times 100$

Where: Σn - total number of germinated seeds at each counting, N - number of total seeds.

Finally, after the fourteenth day, 10 samples randomly selected from each Petri and measuring root length, shoot length and seedling length, seedling dry weight determination. Then, samples placed in the oven for 24 hours at 75° C and weighed on a milligram.

Statistical analyisis

The statistical data were analyzed using MSTAT-C software. The means of the treatments was compared using the least significant difference test at $P < 0.05$ by LSD method.

Result and discussion

Coriander (Coriandrum sativum)

The germination test was performed according to previously bio-fertilizer inoculation on coriander. Nitragin concentrations on germination was not showed reaction.

Table 1. Analysis Variance of traits in fennel.

S.O.V	df	Root length (lr)	Shoot length (ls)	length Seedling	Lr/ls	Root weight (wr)	Shoot weight (ws)	Seedling weight	Wr/ws	Gp	Gr
Treatment	3	152.5**	47.14*	363.93**	0.004*	0.06**	0.05ns	0.051 ns	0.058 **	491*	8.86**
Error	8	5.22	7.57	23.21	0.001	0.005	0.048	0.066	0.003	70	0.63
C.V (%)	_	2.44	3.73	2.88	2.29	14.12	17.38	14.63	13.12	10.52	11.54

Fennel (Foeniculum vulgare)

Radicle length

Analysis of variance for data showed that bio-priming of seed with Nitragin as biological fertilizer at concentrations of 2, 3 and 4 ml and distilled water as control had significantly effect (at 5% level) on crop root length of fennel (Table 1). Results revealed that in those fennel seeds were inoculated with 4 ml Nitragin, root length increased by 6.5%, compared with the control (Table 2). The highest (101 mm) and

lowest (84 mm) of root length was obtained at biological fertilization concentration of 4 and 2 ml, respectively. However the amount of the increase in seed inoculation with Nitragin as biological fertilizer at concentrations of 2, 3 ml, on root length was 94 and 84 mm, respectively. For maximum root length 4 ml Nitragin recommended. Moreover, that the root length and number subsidiary divisions that will increase and this enhances the absorption and root uptake of water and nutrients and ultimately increasing the performance (Saleh rastin., 2001).

Table 2. Comparison of means on fertilizer nitragin on biological traits of fennel.

	Root length (mm)	Shoot length (mm)	length Seedling	Lr/ls	Radicle dry weight (g)	Plumule dry weight (g)	Ratio of Radicle dry weight to Plumule dry weight	Germination%	Growth rate ($g.m^{-2}. day^{-1}$)
2cc nitragin	84.10	68.48	152.6	1.22	0.700	1.20	0.58	85	6.007
3cc nitragin	94.80	73.20	168	1.29	0.370	1.40	0.27	62.33	7.470
4cc nitragin	101.3	77.73	179.1	1.30	0.483	1.10	0.43	78.33	8.973
Control	94.63	75.50	170.1	1.25	0.423	1.35	0.31	92.33	5.043

Means with similar letter were not significant at the 5% probability level.

Plumule length

Effect of seed priming with Nitragin on shoot length was significant at 1% level of probability (Table 1). Inoculation of fennel seeds before planting with 4 cc Nitragin gave rise in shoot length around 3%, compared with un-primed ones (Table 2). Effect of seed inoculation with Nitragin as biological fertilizer at concentrations of 2, 3 and 4 cc and distilled water as control on shoot length of fennel. If the amount of the increase in inoculation with Nitragin as biological fertilizer at concentrations of 2 and 3 cc plumule length, Nitragin 68 mm, 73 mm respectively. Sorial *et al.,* (1992), have reported that inoculation of tomato with some of the nitrogen fixing bacteria such as *Azotobacter*. Increase in seedling length, stem length and shoot dry weight was crop.

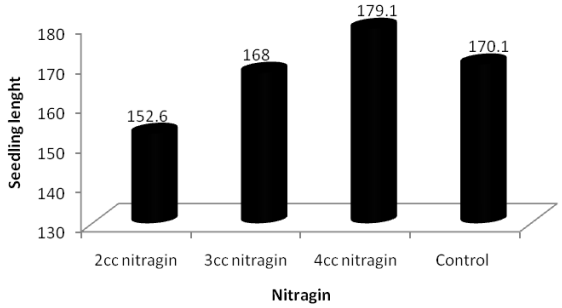

Fig. 1. Comparison of biological effects of fertilizer seedling length fennel.

Seedling length

In seeds treated with 4 cc Nitragin seedling length increased 5% in comparison to control (179 mm). Effect of seed inoculation with Nitragin as biological fertilizer at concentrations of 2, 3 on seedling length of fennel, 152 mm and 168 mm, respectively (Table 2). Sorial *et al.,* (1992) have reported that inoculation of tomato with some of the nitrogen fixing bacteria such as azotobacter Increase in seedling length, stem length and shoot dry weight was crop. The results with the findings Bhadauria *et al.,* (2000) also is consistent. Impregnated with seed, fertilizer to improve plant growth in biological (EL-Zeiny., 2007).

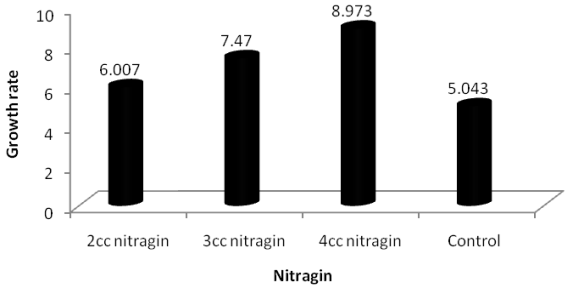

Fig. 2. Comparison of biological effects of fertilizer, growth rate fennel.

Ratio of radicle length to plumule length

The effectiveness of ratio of radicle length to plumule length of fennel seed inoculation with the bio-fertilizer Nitagin, expected that root to shoot ratio is also affected by the treatments, Compared to the

averages (Table 2) indicate that fennel seeds were inoculated with 4 ml of distilled water Nitagin compared with control, The value of this attribute increases by about 3.84%. If the amount of the increase in inoculation with Nitragin as bio-fertilizer at concentrations of 2 and 3 cc ratio of radicle length to plumule length of fennel 1.22 mm and 1.29 mm respectively. Cultures of fennel seeds inoculated with 4 cc Nitagin recommended. Kennedy and Tychan (1997), accelerate seed germination of corn inoculated with *Azotobacter* have reported. *Azotobacter* and *Azospirillum* have a synergistic relationship. 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).

Radicle dry weight of fennel

The highest root dry weight of fennel was observed with the treatment biological fertilizer 2 ml (0.70 g). As the results of the treatments compared (Table 2) showed, fennel seeds were inoculated with 2 ml of Nitragin before planting, root dry weight of fennel around 0.70 g gave rise. The increase in the amount of seed treatment with 3 and 4 Nitragin ml 0.37 and 0.48 respectively. The lowest amount of root dry weight of fennel was obtained with the treatment of biological fertilizer 3 ml (0.37 g). The lowest root dry weight of fennel occurred with 3 ml Nitragin 0.37 g.

Plumule dry weight of fennel

Inoculated fennel seeds with 3 cc Nitragin before planting, gave rise in shoot dry weight of fennel around 1.4 g (Table 2). Impregnated by the seed treatment with 3 ml Nitragin shoot dry weight 1.4 g of the other treatments were and the classes were statistically different. The effect Nitragin 2 ml with 1.2 g, and the effect Nitragin 4 ml with 1.1 g. The highest shoot dry weight of fennel equivalent to 1.4 by 3 ml Nitragin obtained and lowest shoot dry weight of fennel equal to 1.2 g with 2 ml Nitragin priming seeds obtained.

Ratio of radicle dry weight to plumule dry weight

The results showed, in those fennel seeds were inoculated with 2 ml Nitragin, root dry weight to shoot dry weight ratio increased by 45% compared with control. Root dry weight to shoot dry weight ratio is also affected by the treatments, compared to the averages (Table 2) indicate that fennel seeds were inoculated with 2 cc of distilled water Nitragin compared with control, The value of this attribute increases by about 45 percent. If the amount of the increase in inoculation with Nitragin as bio-fertilizer at concentrations of 3 and 4cc on root dry weight to shoot dry weight ratio of fennel 0.27 g and 0.43 g respectively. Cultures of fennel seeds inoculated with 2cc Nitagin recommended.

Percent of Germination fennel

The highest fennel germination percentage equivalent to 92% by water priming obtained and lowest germination percentage equal to 85% with 2cc Nitragin priming seeds obtained. Treatments were compared (Table 2) showed , fennel seeds were inoculated with water priming, the germination percentage than the 92 percent increase and the 2 and 4cc Nitragin, the germination percentage than the 85 and 62 percent respectively. In a study in India, medicinal plants inoculated seeds *Emblica officinalis*, With bacteria brasilense A., Increased 11 percent during the shoot and consequently an increase in 16 percent that were of the seedlings (Bhadauria *et al.,* 2000) .The results with the findings Sorial *et al.* (1992) is also consistent. The effect of treatments on the germination of seeds with azotobacter cumin by Rezai *et al.,* (2005) concluded that the seeds coated with bacteria as compared to 6.25 g per kg of seed germination increases. The germination of the plant cumin epigeal. Relative length of seedlings that seem to improve the use of Nitragin. Early in the green and uniform product under field conditions may play a role.

Growth rate (Gr)

In the highest Nitragin concentration GR increased by 43%, compared in comparison with control. Also, the lowest GR occurred in seeds treated with distilled water. It was concluded that fennel producers could

improve germination and early growth of fennel by seed priming with Nitragin. The results of variance analysis showed that bio-priming of different seed priming showed significant difference at 5% level. The results showed, in those fennel seeds were inoculated with 4 cc Nitragin, crop growth rate increased by 43% compared with control. Results of comparing different levels showed that priming had positive role in increasing crop growth rate. If the amount of the increase in seed inoculation with nitragin as bio-fertilizer at concentrations of 3 and 4 cc on crop growth rate of fennel 7.47 and 8.97 $g.m^{-2}.day^{-1}$ respectively. The lowest crop growth rate of fennel occurred with distilled water about 5 $g.m^{-2}.day^{-1}$. The decrease crop growth rate was 5 $g.m^{-2}.day^{-1}$ without priming (distilled water as control). Cultures of fennel seeds inoculated with 4 cc Nitagin recommended.

Conclusion

The results showed that inoculation with 4 cc Nitragin fennel seeds before planting can, it significantly increased the seedling. Obviously, under these conditions, the seedlings are produced from high vegetative power. This product will eventually increase. Increase the effect of inoculation with the root of this plant Nitragin and the effect of these changes on the length and number of branches and sub-root, fennel seed germination affected by seed treatment with Nitragin rose sharply. The germination of seeds of fennel, it seems that the relative improvement over the use of seedlings in the green timely Nitragin and uniform seed is effective under field conditions.

Reference

Amin IS. 1997. Effect of bio-and chemical fertilization on growth and production of *Coriandrum sativum*, *Foeniculum vulgare* and *Carum carvi* plants. Annals of Agricultural Science **35(4),** 2327-2334.

Ashraf M, Foolad MR. 2005. Presowing seed treatment – A shotgun approach to improve germination, plant growth, and crop yield under saline and non saline conditions. Advanc Agronomy **88,** 223-265.

Badran FS, Safwat MS. 2004. Response of fennel plants to organic manure and bio-fertilizers in replacement of chemical fertilization. Egyptian Journal of Agricultural Research **82(2),** 247-256.

Baleševi-Tubi S, Tati M, Miladinovi J, Pucarevi M. 2007. Changes of fatty acids content and vigor of sunflower seed during natural aging. Helia **30(4),** 61-68. http://dx.doi.org/10.2298/HEL0747061B

Bashan Y, Ream Y, Levanony HL, Sade A. 1989. Non specific response in plant growth yields and root colonization of non cereal crop plants to inoculation with Azospirillum brasilense cd. Canadian Journal of Botany **67,** 1317–1324.

Bashan Y, Holguin G, de-Bashan LE. 2004. Azospirillum- plant relationships: physiological, molecular, agricultural, and environmental advances Canadian Journal of Microbiology **50,** 521–577.

Basra SMA, Zia MN, Mehmood T, Afzal I, Khaliq A. 2003. Comparison of different invigoration techniques in wheat (*Triticum aestivum* L.) seeds. Pakistan Journal of Arid Agriculture **5,** 11–6.

Basra SMA, Farooq M, Tabassum R. 2005. Physiological and biochemical aspects of seed vigor enhancement treatments in fine rice (*Oryza sativa* L.). Seed Science and Technology **33,** 623-628.

Bhadauria S, Pahari GK, Kumar S. 2000. Effect of *Azospirillum* biofertilizer on seedling growth and seed germination of *Emblica officinalis*. Indian Journal of Plant Physiology **5**, 177-179.

Cakmakc RI, Aydın DF, Sahin AF. 2006. Growth promotion of plants by plant growth-promoting rhizobacteria under greenhouse and two different

field soil conditions. Soil Biol. Biochem **38**, 1482–1487.

El-Ghadban EAE, Shalan MN, Abdel-Latif TAT. 2006. Influence of biofertilizers on growth, volatile oil yield and constituents of fennel (*Foeniculum vulgare* Mill.). Egyptian Journal of Agricultural Research **84(3),** 977-992.

Ellis RH, Roberts EH. 1981. The quantification of ageing and survival in orthodox seeds. Seed Science and Technology **9**, 377-409.

El-Zeiny OAH. 2007. Effect of biofertilizers and root exudates of two weed as a source of natural growth regulators on growth and productivity of bean plants (*Phaseolus vulgaris* L.). Journal of Agriculture and Biological Science **3 (5),** 440-446.

Farooq M, Basra SM A, Hafeez K, Ahmad N. 2005. Thermal hardening: a new seed vigor enhancement tool in rice. Acta Botany Sience **47**, 187–193.

Gad WM., 2001. Physiological studies on *Foeniculum vulgare* Mill. and *Anethum graveolens* L. M.Sc. Thesis. Faculty Agric., Kafr El-Sheikh, Tanta Univ., Egypt.

Kennedy IR, Tychan YT. 1997. Biological N fixation in non-legominous field crops: Recent Advances. Plant and Soil **141**, 93-118.

Maguirw, ID. 1962. Speed of germination-aid in selection and evaluation for seedling emergence and vigor. Crop Science **2**, 176-177.

Mahfouz SA, Sharaf-Eldin MA. 2007. Effect of mineral vs. biofertilizer on growth, yield, and essential oil content of fennel (*Foeniculum vulgare* Mill.). International Agrophysics **21**, 361-366.

Okon Y. 2002. Azospirillum, physiological properties, mode of association with roots and its application for the benefit of cereal and forage grass crops. Israel journal of Botany **31**, 214-220.

Rezai M, Agashahi S, Siyadi M. 2005. Effect of nitrogen fixiation bacteria on germination cumin(*Cuminum cyminum*). Iran hush science congress four. july mouth17-19. mashhad ferdosi university.

Saleh rastin N. 2001. Biofertilizers and role their in sustainable agriculture. Products necessary article Collection industry biofertilizers in country. Research structure issuance, Instruction and promotion agriculture 1-54.

Sorial ME, SR EL-Khateeb, Ali FA. 1992. Synergistic effect of Azotobacter on the growth, N, P and K contents of tomato and activity of some pathogenic fungi Menofia. Agricultural Research **17 (4),** 1999-2014.

Yousry M, OM Kabesh, Seif KH. 2003. Manganese availability in a calcareous soil as a result of phosphate fertilization and inoculation with phosphobacterin. African Journal of Agriculture Science **5(2),** 75-80.

Tehlan SK, Thakral KK, Nandal J. 2004. Effect of *Azotobacter* on plant growth and seed yield of fennel (*Foeniculum vulgare* Mill.). Haryana Journal of Horticulture Science **33(3/4),** 287-288.

Tilak KVBR, Singh CS, Roy NK Subba Rao NS. 1992. *Azospirillum brasilense* and *Azotobacter chrococcum* inoculum effect on maize and sorghum. Soil Biol. Biochem **14**, 417-418.