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Research Article

Effect of some chemical and biofertilizers on growth, yield and essential oil of Basil (*Ocimum basilicum* L.)as medicinal plant

Amir Hassan Asadian[1], Abasalt Rostami Ajirloo[2] and Morad Shaaban[3]

[1]Lecturer, Department of Agronomy and Plant Breeding,
College of Sarayan, University of Birjand, Birjand, Iran
[2]Young Researchers and Elite Club, Parsabad branch, Islamic Azad University, Parsabad, Iran
[3]Young Researchers and Elite Club, Borujerd branch, Islamic Azad University, Borujerd, Iran
*Corresponding author:asadian@birjand.ac.ir

ABSTRACT

This study was laid out in order to evaluation of effect of some chemical and biofertilizers on growth, yield and essential oil of Basil (*Ocimumbasilicum* L.) at 2016. Experiment was conducted in a randomized complete block with seven treatments and three replications. Treatments was application of some biological fertilizers such as Nitroxin, Nitrokara and Supernitroplass and foliar spray of Urea solution at a rate of 1, 2 and 3% (in two stages, the first stage a month after transplanting when they had reached 10 cm in height to 20 days after the first stage and second stage). Plant height, Chlorophyll content in two phases, one week after the first treatment and harvest samples were measured by chlorophyll meter SPAD manually. Fresh and dry matter yield and essential oil were determined. The results showed that, application of chemical and biological fertilizers increased height of Basil. Chlorophyll content in stage 1 and 2 sampling was increased by application of different fertilizers compared to control. Increasing of fresh and dry matter yield was obtained in application of biological and chemical fertilizers but application of Nitroxin biofertilizer had the highest fresh and dry matter yield. Also, Niteroxin biofertilizer had the highest fresh and dry matter yield and control treatment had the lowest. The results showed that, between all biological and chemical fertilizers, application of Nitroxin biofertilizer was more efficient on growth, yield and essential oil of Basil.

Key words: Basil, biofertilizer, essential oil and Nitroxin

INTRODUCTİON

Biofertilizer is a material containing microorganism(s) added to a soil to directly or indirectly make certain essential elements available to plants for their nutrition. Various sources of biofertilizers include nitrogen fixers, phytostimulators, phosphate solubilizing bacteria, plant growth promoting rhizobacteria and etc [1]. Application of biofertilizers became of great necessity to get a yield of high quality and to avoid the environmental pollution [2]. Forgive to highest seed yield in agriculture addition to both nitrogen and phosphate fertilizer is very important [3, 4]. Forgive the highest seed yield in barley should apply both nitrogen and phosphate bio fertilizers. Use of these microorganisms as environment friendly biofertilizer helps to reduce

the much expensive phosphatic fertilizers. Phosphorus biofertilizers could help to increase the availability of accumulated phosphate (by solubilization), efficiency of biological nitrogen fixation and increase the availability of Fe, Zn etc, through production of plant growth promoting substances [5]. Increased root, shoot weight with dual inoculation in maize have been reported by [6], while grain yields of the different maize genotypes treated with *Azospirillum spp*. Seed inoculation with Rhizobium , phosphorus solubilizing bacteria, and organic amendment increased seed production of the crop [7].

The production of chemical fertilizers is a highly energy-intensive process using large amounts of fossil energy. High-input farming practices achieving high yields have created environmental problems and degradation in natural resources [8]. Large quantities of chemical fertilizers are used to replenish soil N and P, resulting in high costs and severe environmental contamination. Consequently, there has recently been a growing level of interest in sustainable agricultural practices to alleviate detrimental effects of intensive farming currently practiced [8]. Increasing and extending the role of biofertilizers would reduce the need for chemical fertilizers and decrease adverse environmental effects. Microorganisms are important in agriculture in order to promote the circulation of plant nutrients and reduce the need for chemical fertilizers [8].

Basil *(Ocimumbasilicum*Linn.) commonly known as French basil or sweet basil is an important aromatic plant cultivated in many parts ofthe world for its essential oil [9]. Most culinary and ornamental basils are cultivars of the species *Ocimum basilicum*, but other species are also grown and there are many hybrids between species. The genus of *Ocimum*, of the family *Lamiaceae* (*Labiatae*), include at least 60 species and numerous varieties [10]. *Ocimum* spp. contain a wide range of essential oils rich in phenolic compounds and a wide array of other natural products including polyphenols such as flavonoids and anthocyanins [11]. Leaves and flowering parts of O. basilicum are traditionally used as antispasmodic, aromatic, carminative, digestive, galactogogue, stomachic, and tonic agents [12, 13].

Packages for production of basil oil are being developed in a semi-aridtropical climate where avariety of commercially important essentialoils are produced [9]. Several cultivars of different chemo types of basil like methyl chavicol / methyl cinnamate / eugenol / geranioland linalool types have been reported [14]. Basil being a foliage rich crop responds well to application of NPK. In spite of high domestic and international demand, the crop has not received its due importance in evolving appropriate agro-technologies for its cultivation to enhance productivity [15]. Rich chemical composition, as well as unique taste and flavor have recently gained basil its considerable position and wide-range use in Polish cuisine. Basil`s leaves areused as spices both when fresh and after being frozen or dried. The level of basil oil (flavor) varies according to its origin of plantation from 0/5-1/5y [16]. Busily oil is a yellow or greenish liquid, is aromatic and non-soluble in water, but will be solved up to times of its volume in soy Alcohol This not soluble in there or chloral form. Basil essence is composed of 30-15% straggle or methyl-cervical, linalool;, cineol, methyl cinematic, Eugnol and etc [17].

The aim of research was the assessment of the effect of chemical and biological fertilizers on yield and essential oil of basil.

MATERİAL AND METHODS

The experiment was carried out in 2016 at the Agricultural Research Farm of college of Sarayan, Birjand University, Iran. Experiment was conducted in a randomized complete block with seven treatments and three replications. Foliar spray of Urea solution at a rate of 1, 2 and 3% (in two stages, the first stage a month after transplanting when they had reached 8 cm in height to 15 days after the first stage and second stage) and application of some biofertilizers such

as Nitroxin, Nitrokara, Supernitroplass and control.

Chlorophyll in two phases, one week after the first treatment and harvest samples were measured by chlorophyll meter SPAD manually. For measuring chlorophyll measurements in two phases, one week after the first and second SA of four leaves on each 5 stem from each plot were randomly selected and handheld devices, manually chlorophyll meter CCM200 model was measured and the average of these four chlorophyll readings as treatment were considered. Essential oil extracted from the leaves and twigs using 50 g samples of each treated flower with water distillation by Clevenger apparatus was performed. The essential oil extracted by steam distillation method (water distillation) and by Clevenger apparatus (Clevenger) was performed .then the mixture was poured into a liter of powder and water balloons Clevenger was placed on the machine and after reaching the boiling point was boiled for 2 h. With water vapor as the refrigerant oil distillation unit and were compiled. Oil and water into the water pipes were scaled back and then again inside the balloon distillation and condensation cycle oil into the micro tube Clevenger apparatus to produce (glass milliliter small 1) poured. At maturity fresh and dry matter yield were determined.

The statistical analyses to determine the individual and interactive effects of time cultivation and weeds control methods were conducted using JMP 5.0.1.2 (SAS Institute Inc., 2002). Statistical significance was declared at $P \leq 0.05$ and $P \leq 0.01$. Treatment effects from the two runs of experiments followed a similar trend, and thus the data from the two independent runs were combined in the analysis.

RESULT AND DİCCUSSİON

Plant height: The results showed that the effect of fertilizer treatment was significant on plant height (table 1). The maximum Plant height (41 cm) was obtained in application of Nitroxinbiofertilizer but minimum of plant height (26.9 cm) was recorded in control treatment. After biological fertilizers, application of chemical fertilizers was higher plant height compared to control (Table 2).

Chlorophyll SPAD: The results of the analysis of variance table showing the effect of fertilizer treatment on chlorophyll index was significant at the one percent level (Table 1). Both in 1 and 2 stages of sampling, the maximum chlorophyll SPAD was obtained in application of Nitroxin biofertilizer. However application of Urea 3% was more efficient than 2% and 1% but was lower than application of Nitrokara and Supernitroplass biofertilizers. Minimum Chlorophyll SPAD in stage 1 and 2 was obtained in control treatment (Table 2).

S.O.V	DF	Plant height	Primary chlorophyll SPAD	Secondary chlorophyll SPAD	Fresh yield	Dry matter yield	Essential oil content (%)	Essential oil yield
Block	2	31	0.29	55.2	5623568*	125865*	0.056	1.956
Treatment	6	89.23**	31.23**	122.3**	7542659**	136589**	0.231**	19.33*
Error	12	5.23	9.22	23.2	365495	19568	0.021	1.23
CV(%)		11	7.2	9.3	8.22	6.32	10.2	8.56

Table 1. Analysis of variance (mean squares) for effects of chemical and biological fertilizers on growth, yield and essential oil of Basil

* And **: Significant at 5% and 1% probability levels, respectively

Fresh yield: The results of analysis of variance showed that the effect of fertilizer treatment on fresh yield was significant at the one percent level (Table 1). The maximum fresh yield (8956 kg/ha) was obtained in application of Nitroxinbiofertilizer but minimum of fresh yield (6523 kg/ha) was recorded in control treatment. After biological fertilizers, application of chemical fertilizers was higher fresh yield compared to control (table 2).

Dry matter yield: The effect of fertilizer treatment on dry matter yield was significant at the one percent level (table 1). The mean comparison results showed that application of biological fertilizers such as Nitroxin, Nitrokara and Supernitroplass were more efficient than chemical application of 1, 2 and 3 percent Urea in compared to control. The maximum dry matter yield (2111 kg/ha) was obtained in application of Nitroxin biofertilizer but minimum of dry matter yield (1325 kg/ha) was recorded in control treatment (Table 2).

Essential oil content: The effect of fertilizer treatment was significant essential oil content (Table 1). Application of biological and chemical fertilizers had a positive effect on essential oil content but biological fertilizers were more efficient. In the present study application of Nitroxin biofertilizer treatment had the highest essential oil content (1.23%) and control treatment had the lowest essential oil content (0.92 %). Application of Urea 3% was more positive rather than other Urea percentage (Table 2).

Table2. Mean comparisons for effects of chemical and biological fertilizers on growth, yield and essential oil of Basil

Fertilizer Treatments	Plant height (cm)	Primary chlorophyll SPAD	Secondary chlorophyll SPAD	Fresh yield (kg/ha)	Dry matter yield (kg/ha)	Essential oil content (%)	Essential oil yield (kg/ha)
Control	26.9d	31c	28c	6523e	1325e	0.92c	6.12d
Nitroxin	41a	41a	38a	8956a	2111a	1.23a	12.98a
Nitrokara	38.32b	40a	36a	8756a	2021ab	1.01b	10.20b
Supernitroplass	37b	40a	35ab	85625b	1923b	1.11ab	10.67b
Urea (1%)	32.3c	33bc	30bc	7855d	1655d	0.95c	7.86cd
Urea (2%)	36bc	35b	33b	8125c	1822c	0.96c	8.74c
Urea (3%)	37.6b	34b	33b	8623b	1956b	1.13ab	11.05ab

Means by the uncommon letter in each column are significantly different ($p<0.05$).

Essential oil yield: The results showed that the effect of fertilizer treatment was significant essential oil yield (Table 1). The results of mean comparisons showed that the maximum essential oil yield (12.98 kg/ha) was obtained in application of Nitroxin biofertilizer and control treatment had the lowest essential oil yield (6.12 kg/ha). Application of Nitrokara and Supernitroplass biofertilizers had the more positive effect on essential oil yield rather than 1, 2 and 3 percent Urea as chemical fertilizer (Table 2).

Basil is a widely grown aromatic crop cultivated either for production of essential oil, dry leaves for the fresh market, or as an ornamental. Today, utilization of biofertilizers has become a feasible production practice. Biofertilizers can enhance plant growth, nitrogen fixation, hormone production, plant nutrition and also control of plant diseases. The results of this study reviled that application of chemical and biological fertilizers increased growth of Basil. Increasing of plant height was performed in result of growth increased. However application of biological fertilizers especially Nitroxin had more positive effect on Basil plant height (Table 2).

Many marketable biofertilizers are mainly based on biofertilizers that exert beneficial effects on plant development often related to the increment of nutrient availability to host plant [14]. Physiological improvement such as increasing of chlorophyll content had the main role in increasing of dry matter and oil yield of medicinal plant. In the present study chlorophyll content in stage 1 and 2 sampling was increased by application of different fertilizers compared to control. However application of Nitroxin, Nitrokara and Supernitroplass biofertilizers was more efficient than chemical fertilizers (table 2). Photosynthetic material exchange activity is stimulated through symbiosis with

microorganisms in inoculated plants that increases the efficiency of photosynthetic phosphorus. Therefore, it may be concluded that photosynthetic capacity of plants treated with phosphors-solving microorganism's increases due to increased supply of phosphors nutrition. Seed weight also increases due to better transfer of photosynthetic substances. Therefore, reduced production of photosynthetic substances due to a smaller green surface area decreased the conservation content of photosynthetic substances due to having short internodes or high levels of ABA during the above–mentioned critical period. Results were similar to previous research [1, 18, 19]. Other reports showed beneficial effect of biofertilizers on plant growth. Increased nutrient uptake by plants inoculated with plant-growth promoting bacteria has been attributed to the production of plant growth regulators at the root interface, which stimulated root development and resulted in better absorption of water and nutrients from the soil [20, 21, 22].

Long term field studies showed a significant contribution of biofertilizers for the yield increase of the field crops, which vary in range from 8–30% of control value depending on crop and soil fertility. The rhizosphere competence of native bacteria for C sources was major determinant for the success of inoculants [23]. Increasing of fresh and dry matter yield was obtained in application of biological and hemical fertilizers but application of Nitroxinbiofertilizer had the highest fresh and dry matter yield (Table 2). As free living, nonphotosynthetic bacteria depend on soil organic matter as a food source, enhanced bacterial populations in the mixtures possibly increased competition for energy sources in the soil [8]. Mixed microbial cultures allow their components to interact with each other synergistically, thus, stimulating each other through physical or biochemical activities [24]. With increasing and improving of these traits, fresh and dry yield were increased. Biofertilizers can improve plant growth, plant nutrition, root growth pattern, plant competitiveness and responses to external stress factors. Many microorganisms in the soil are able to solubilize 'unavailable' forms of Kbearing minerals, such as micas, illite and orthoclases, by excreting organic acids which either directly dissolves rock K or chelate silicon ions to bring the K into solution [24, 25].

In the present study application of biological fertilizers had more positive effect on essential oil content and yield. Niteroxin biofertilizer had the highest fresh and dry matter yield and control treatment had the lowest (Table 2). Several studies have shown that proper levels of nitrogen significantly increased the essential oil of peppermint [26]. The use of nitrogen fertilizers sprayed on the green parts of the plant compared to the direct use of the soil has led to the further production of essential oil of fennel [22]. According to the diagram, the effect of treatments on essential oil yield can be substantially increased application of vermicompost has this trait. It seems that since vermicomposting compost nutrients more available to plants form of nitrate, phosphate, potassium and exchangeable Ca solution is therefore to increase performance is essential. Increase in oil yield has been reported by several researchers [27, 28].

CONCLUSSION

In final, the results of the present study showed that application of biological and chemical fertilizers had the positive effect on growth, yield and essential oil on Basil. However, application of biological fertilizers was more efficient on them. Between all biological and chemical fertilizers, application of Nitroxin was more efficient on growth, yield and essential oil of Basil and increased them more than other fertilizers compared to control.

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