Trends in Applied Sciences Research

ISSN 1819-3579

Academic
Journals Inc.

www.academicjournals.com

Trends in Applied Sciences Research 2 (5): 451-455, 2007
ISSN 1819-3579

Effect of Micronutrients Supplement on Growth of *Nigella sativa*, *Coriandrum sativum* and *Ptychotis ajowan*

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Abstract: The effect of newly developed fertilizer named Fertilizer fritz (composed of Fe, Cu, Mn, Zn and B) on the growth responses, yield and uptake of micronutrients in the three medicinal plants *Coriandrum sativum* (Coriander), *Nigella sativa* (Kalonji) and *Ptychotis ajowan* (ajwain desi) were studied. Experiments were conducted in the fields of PCSIR Laboratories Complex, Karachi during October 1999 to May 2000 in randomized complete block design with three replications. The analysis of the data revealed that the formulation had a significant effect on plant height, length of leaves, yields of total plant, seeds, roots and stem. Maximum plant height was recorded in *C. sativum* (80%). Increases in the yield of plant material were about 45-95% in *C. sativum*, 25-60% in *N. sativa* and 5-40% in *P. ajowan*. Increases in the oil contents were 11.0, 8.80 and 7.60% for *C. sativum*, *N. sativa* and *P. ajowan*, respectively over control. In general plant responses towards the new formulation were in the order *C. sativum*>*N. sativa*>*P. ajowan*.

Key words: Micronutrient, fertilizer, *Coriandrum sativum*, *Nigella sativa*, *Ptychotis ajowan*, oil content

INTRODUCTION

Micronutrients application plays an important role in the production of good quality and high yield of crops (Rashid *et al*., 2005). The role of micronutrients (i.e., Mg, Fe, Zn, Cu etc.) in photosynthesis, N-fixation, respiration and other metabolic processes of the plant is well documented (Hussain *et al*., 2006). The largest proportion of Mg is found in the porphyrin moiety of chlorophyll molecule. It is also required to stabilize ribosome structure and is involved in stabilizing various critical enzymes. Fe is a part of the catalytic group for many redox enzymes including heme containing cytochromes and non heme iron-sulphur proteins as well as several oxidases (i.e., catalase and peroxidases). It is also required for the synthesis of chlorophyll. Similarly Zn is an activator of a large number of enzymes including alcohol dehydrogenase, carbonic anhydrase and superoxide dismutase. Copper functions as a cofactor for a variety of oxidative enzymes including the photosynthetic electron carrier plastocyanin, cytochrome oxidase and superoxide dismutase (Hopkins, 1999).

It is reported that soil of Pakistan is deficient in some micronutrients especially in iron and zinc (Rafique *et al*., 2005; Rashid *et al*., 1997). Generally nitrogen, phosphorus and potassium are used in fertilizers for plant growth whereas efficiency of micronutrients used in fertilizer is very low, in the range of 2-5%, therefore, balanced and integrated plant nutrient supply and management involve low doses of organic materials, city compost/sludges to enhance the use efficiency of native and applied micronutrients and for restoring soil fertility (Singh, 1999). Trace elements deficiency may create complicated production restriction. The disorder and deficiency of nutrients depress the plant yield drastically. Recently World Health Organization (WHO) has expressed serious concern over plant

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food micronutrient deficiencies that limit the physical and intellectual capacity of people and emphasized that agriculture must provide enough nutrients to sustain healthy, productive lives and for the production of enough food (Graham and Welch, 2000).

Coriandrum sativum (family: Umbellifereae), *Nigella sativa* (family: ranunculaceae) and *Ptychotis ajowan* (family: Umbellifereae) are the well known medicinal plants, widely used in the preparation of herbal and synthetic medicines. Seed oil of *N. sativa* commonly known as Kalonji oil is used in bronchial dilation, asthama and lowering of blood pressure. Oil of *P. ajowan* is used as an antiseptic and aromatic carminative. Oil of *C. sativum* is aromatic, stimulant and carminative (Ali and Blunden, 2003; Vejdani *et al*., 2006). Yield responses of *C. sativum*, *N. sativa* and *P. ajowan* to micronutrient application have been reported in literature (Parieri *et al*., 2003; Maurya, 1990; Li, 1976). Keeping in view the role of various micronutrients in the nutrition of crops, present study was planned to cultivate these medicinal plants using micronutrient based formulation of fertilizer known as Fertilizer Fritz (brand name Zar Zamin) developed by PCSIR laboratories complex, Karachi. The aim of present research was that the increased yield and improved quality of these plants will be utilized for commercialization of indigenous resources.

MATERIALS AND METHODS

The seeds of medicinal plants *Nigella sativa*, *Coriandrum sativum* were purchased from the local market while that of *Ptychotis ajowan* were purchased from Hamdard Clinic, Karachi. Crops were grown in randomized complete block design, replicated thrice in the experimental field of PCSIR Laboratories Complex, Karachi. Experiments were carried out from October 1999 to May 2000. The minimum and maximum temperature during this period was 26 to 34°C. Six plots were used for each plant. Each plot had an area of 15 ft^2. The soil was prepared by mixing sweet sand and well composted cow dung manure in a ratio of 1:2. Water supply was regulated once a week in the beginning and then after 15 days interval. In three plots 10 g special micronutrients preparation Fertilizer Fritz was added in the soil while the other three were without micronutrients and treated as control. Fertilizer fritz was composed of Fe, Cu, Mn, Zn and B.

Ten grams seeds were planted in the first week of October and the crop was harvested in May. The data was collected for the change in behaviour of germination, growth and yield of treated and control plants. Fully-grown plant samples were taken along with roots, stems, leaves and seeds. Five randomly selected plants from each plot were taken along with the soil core. The soil mass adhering to roots was removed carefully by gentle stirring in water. Each part of the plant was separated from each other, washed with tap water and then with distilled water. The samples were dried in an air oven first at 75°C and then at 100°C for one hour and weights were recorded separately. The dried material of roots, stem, leaves and seeds were ground and mixed thoroughly. Yields were calculated by substracting the dry weights of different parts of treated plants from that of control plants. Micronutrients concentration was determined on atomic absorption (Hitachi Z-8000 coupled with Zeeman's correction) using DTPA extraction method (Chaudhry *et al*., 1978). Organic matter was determined by dichromate method (Welcher, 1963).

Soil analysis showed that it contained sand 72.5%, clay 12.6% and slit 12.4%. Its texture was loamy sand and have organic matter 3.5% and $CaCO_3$ 15.5%. DTPA extract of soil contained Fe (61.8 ppm), Cu (0.20 ppm), Mn (13.9 ppm), Mg (96.0 ppm) and Zn (8.9 ppm). pH of the soil was 7.8, determined in a suspension of soil and water (ratio 1:2) on a pH meter using a glass electrode. Its moisture content was 5.98%.

Seed oil of three plants were obtained by extracting seeds with 95% distilled alcohol. Solvent was removed on rotary evaporator and the dry ethanol extract was further extracted with petroleum ether exhaustively to obtain total oily fraction.

RESULTS AND DISCUSSION

The effectiveness of micronutrients in preventing and correcting nutritional disorders and in supplying the nutritional needs of a crop is well understood (Reid, 2001). Micronutrient feeding constitutes one of the important milestones in the progress of agriculture crop production (Rashid and Ryan, 2004). The effect of micronutrients present in the formulation Fertilizer fritz on growth rate, yield, oil content and uptake of micronutrients in three plants *Nigella sativa* (Kalonji), *Ptychotis ajowan* (Ajowan Desi) and *Coriandrum sativum* (Coriander) were investigated.

Results obtained in Table 1 showed that treated plants of *N. sativa* and *C. sativum* behaved in a similar fashion and started growing 6-10 days earlier than the control plants. Flowering was started earlier in the treated plants and increase in the plant height was about 2.0 cm. An average increase in the length of leaf was 0.3 cm. In case of *P. ajowan* no significant difference was observed in the appearance and flowering of the treated and control plants whereas an increase was noticed in the plant height and size of the leaf of treated plants as compare to the control. Overall results showed that treated plants were healthier, larger in size and quicker in growth.

Application of Fertilizer fritz showed positive impact on the yield of plants as a whole and on their constitutive parts. Yield of *C. sativum* was significantly high ranged between 45-95% (Table 2). The possible reason could be that Fertilizer fritz may have provided balanced level of the micronutrients required for different physiological and biochemical processes in *C. sativum* which had resulted in the maximum yield in all respect.

A substantial increase was observed in the yield of total plant of *P. ajowan* (40%) while its seed yield (5%) was lowest among the three plants. This indicated some non supporting effect of the Fertilizer fritz or may be it needs some dose adjustment. Yield of stem and roots were nearly same in *P. ajowan* and *N. sativa*. Better yield of total plant (60%) and seeds (55%) were found in *N. sativa*. Parieri *et al*. (2003) reported that application of Boron 0.1% and Zinc 0.2% enhanced twice most of the yield attributes including seed yield (6.63 q ha^{-1}) of *N. sativa* and also observed that combined application of Boron and Zinc particularly at lower doses promoted mostly the vegetative parameters of *N. sativa*. Previous studies also showed that *ajowan* plant responded well with nitrogen fertilizer, seed yield and nutrient concentration were significantly increased with the high doses of nitrogen (Ashraf and Noman, 2006).

Effect of fertilizer fritz was observed on the oil content of all three plants. Results in Table 2 showed that ethanol extract and oil content were maximum in *C. sativum* i.e., 18.8 and 11.0%, respectively. Increases in the oil content were found as *C. sativum*>*N. sativa*>*P. ajowan*. Khattab and

Table 1: Cultivation record (1999-2000)

	Nigella sativa		*Ptychotis ajowan*		*Coriandrum sativum*	
Parameters	Control	Treated	Control	Treated	Control	Treated
Date of sowing	30.10.1999	30.10.1999	02.11.1999	02.11.1999	26.11.1999	26.11.1999
First appearance of plant	19.11.1999	07.11.1999	16.11.1999	16.11.1999	06.12.1999	01.12.1999
Average height of plant (cm)	3. 65	5.50	4.87	8.15	3.20	5.25
Flowering started	01.12.1999	26.11.1999	16.12.1999	14.12.1999	28.01.2000	20.01.2000
Date of harvesting	10.04.2000	10.04.2000	02.05.2000	02.05.2000	31.03.2000	31.03.2000
Average length of leaf (cm)	0.70	1.00	0.89	1.49	0.58	0.96

Table 2: Increases in yield (g% w/w) of total plants, and their constitutive parts and oil content after treating with fertilizer fritz

Parts of plant	*Nigella sativa*	*Ptychotis ajowan*	*Coriandrum sativum*
Total plant	60.00	40.00	80.00
Total stem	35.00	35.00	95.00
Total seeds	55.00	5.00	75.00
Total roots	25.00	30.00	45.00
Ethanol extract of seeds	12.94	10.64	18.80
Oil of seeds	8.80	7.60	11.00

Table 3: Micronutrients composition (ppm) of three medicinal plants

Name of plants	Parts of plant	Fe		Cu		Co		Mn		Mg	
		C*	T♦	C*	T♦	C*	T♦	C*	T♦	C*	T♦
Nigella sativa	Roots	452.35	430.78	11.56	12.90	Nil	Traces	12.60	13.70	1450.21	1459.02
	Stem	252.73	257.81	7.71	8.20	Nil	Traces	11.66	12.90	1520.33	1535.20
	Leaves	390.92	396.56	10.35	11.40	Traces	Traces	44.20	48.97	2050.65	2059.91
	Seeds	120.54	125.96	8.54	8.97	Nil	Traces	12.35	11.98	1662.72	1678.93
Ptychotis ajowan	Roots	540.01	546.92	10.00	11.67	Nil	Traces	36.95	35.64	1900.64	1920.55
	Stem	356.20	359.71	13.20	15.05	Nil	Traces	42.60	43.96	1507.91	1525.62
	Leaves	486.72	489.83	12.54	13.24	Traces	3.06	40.10	43.20	1886.03	1892.84
	Seeds	186.90	190.73	9.96	10.56	Traces	Traces	15.64	14.21	1435.75	1440.66
Coriandrum sativum	Roots	526.34	532.15	13.90	14.65	3.56	2.22	32.50	33.79	2644.91	2652.62
	Stem	289.01	292.73	15.87	16.98	Nil	Nil	40.67	41.27	2803.33	2815.64
	Leaves	352.62	359.47	10.89	10.96	Traces	Traces	48.88	52.00	2900.56	2915.67
	Seeds	110.35	112.54	8.50	9.20	Traces	Nil	14.93	15.66	1906.28	1900.59

*Control plant, ♦Treated plant

Omer (1999) reported increase in plant growth, yield and essential oil content of caraway, anise and coriander by the application of micronutrients, they noticed that trace elements in dry fruits were also increased with increasing the fertilizer treatment. Similarly Maurya (1990) stated that micronutrient application of $CuSO_4$ and $ZnSO_4$ increased the yield of coriander fruits in respect of Cu and Zn to 28 and 23.21%, respectively, essential oil content of coriander seeds were also increased. Singh (1999) showed that use of zinc, boron, iron, manganese and sulphur was not only beneficial to cereals but to oil seeds, pulses and cash crops of deficient soils. He also observed that soil application of zinc, boron and sulphur was more efficient than their foliar application and vice versa for iron and manganese for several crops.

Uptake of micronutrients in various parts of these medicinal plants presented in Table 3 showed that except in few cases, virtually there was no significant difference in micronutrient content of treated and control plants. Data showed that higher concentration of Fe was observed in leaves and roots of plants while stems and seeds had comparatively less amount of iron. Cu and Co were found in traces. Mn and Mg were in the permissible limit. The estimated values of Fe and Cu in seeds of *N. sativa* in the present study were found similar in range as described earlier in this plant (Takruri and Dameh, 1999). It was reported that excess use of nutrients (both micro and macro) exerts strong toxic effects on crop growth (Mortvedt *et al*., 1972). Ashraf *et al*. (2005) observed that increase in the level of nutrients in plant tissues of *N. sativa* showed a negative impact on the growth of crop. El-Ghamery *et al*. (2003) described that higher concentration of Zinc sulphate (Zn^{2+}) fertilizer treatment was toxic for the germination and root growth of *Nigella sativa* and *Triticum aestivum*.

The result obtained in the present study exhibited that there was no significant uptake of micronutrient in treated plants. On the other hand the application of micronutrients Fertilizer fritz had supplied a balanced (minor quantity) of all the micronutrients to *C. sativum* and *N. sativa* suggesting their important role in enhancing growth, yield and oil contents of these plants while *P. ajowan* did not respond well to the formulation, may be it needs some dose adjustment of fertilizer and some more experimental study.

ACKNOWLEDGMENTS

The authors are thankful to Mr. Muhammad Javed, Sr. Technician and Muhammad Sadiq Ali, Junior Technical Officer for assistance in this research.

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