Journal of Spices and Aromatic Crops
Vol. 24 (2) : 149-152 (2015)
www.indianspicesociety.in/josac/index.php/josac

Indian Society for Spices

Influence of different plant growth regulators and zinc levels on growth and quality aspects of fenugreek (*Trigonella foenum-graecum* L.) under semi-arid conditions

A Singh, S P Singh*, A K Mahawar & T V Yadav

SKN College of Agriculture, Jobner-303 329, Rajasthan.
**E-mail: singhsp072@gmail.com*

Received 21 August 2013; Revised 16 July 2014; Accepted 22 December 2014

Abstract

The experiment was conducted to study the influence of different plant growth regulators and zinc (Zn) levels on growth and quality attributes of fenugreek (*Trigonella foenum-graecum* L.). The results revealed that foliar application of triacontanol and NAA increased the growth attributes and uptake of N, P and Zn significantly over control and thiourea application. Growth regulator sprays were superior to control with regard to N, P and Zn concentration in seed & straw and protein content in seed. Application of Zn @ 4 kg ha^{-1} significantly increased the growth and quality attributes compared to 0 and 2 kg Zn ha^{-1}.

Keywords: fenugreek, NAA, plant growth regulators, thiourea, triacontanol, zinc

Fenugreek (*Trigonella foenum-graecum* L.) is a seed spice, also grown for its leaves. Use of plant growth regulators (PGRs) can have a greater impact in increasing yield and quality when applied at a specific or critical growth stage (Nehara *et al.* 2006). Zinc (Zn) is an essential constituent of tryptophan amino acid which is a precursor of auxins. Application of Zn facilitated increase in growth and yield in legumes (Choudhary 2006), but in many parts of India, Zn is now considered third important plant nutrient next only to N and P. Very less work was done on effect of combined application of growth regulators and Zn. Hence, the present experiment was conducted to find out effect of different plant growth regulators and Zn levels on growth and quality attributes of fenugreek in semi arid conditions.

The experiment was conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during 2006–07 *rabi* season. The soil of experimental field was alkaline loamy sand in texture with pH 8.1, poor in organic carbon (0.135%), available N (134.70 kg ha^{-1}), P (16.85 kg ha^{-1}), K (151.65 kg ha^{-1}) and Zn (0.42 mg kg^{-1} soil). The experiment was laid out in randomized block design (RBD) and comprised of four plant growth regulators application (Control, Triacontanol @1000 ppm, NAA @50 ppm, and Thiourea @500 ppm) and four Zn levels (Control, 2, 4 and 6 kg ha^{-1}). Fenugreek seed of variety RMt-1, was sown in plot of size was 3.0 × 1.8 m^2 @25 kg ha^{-1} with 30 × 15 cm spacing between rows and plants. Two foliar sprays of Triacontanol @1000 ppm, NAA @50 ppm and thiourea @500 ppm in the form of

miraculam (0.05%), planofix (4.5%) and thiourea (99.9%), respectively were done at 40 and 60 DAS. Zn as per treatments was drilled manually to a depth of 10 cm in furrow as $ZnSo_4.7\ H_2O$ prior to sowing. Growth attributes like plant stand, dry matter content, plant height, number of branches plant^{-1}, number and dry weight of root nodules plant^{-1} were calculated following standard procedures. Total chlorophyll content was estimated with the method as recommended by Arnon (1949). Nitrogen content was estimated by wet digestion of samples with Nessler's reagent (Snell & Snell 1949) and N content was multiplied with 6.25 to arrive at crude protein content in pod (AOAC 1975). Phosphorus concentration was determined by 'Vanadomolybdate' phosphoric acid yellow colour method and the intensity of colour was measured by Spectrophotometer (AOAC 1975). The Zn component (ppm) of seed and straw was estimated with atomic absorption spectrophotometer (Lindsay & Norwell 1978). The 'F-test' and critical difference (CD) was calculated to test significance of difference among the treatments.

Foliar application of 50 ppm NAA and 1000 ppm triacontanol significantly increased plant height, branches plant^{-1}, dry matter accumulation, number and dry weight of root nodules and chlorophyll content over control (water spray) and thiourea (Table 1). The foliar spray of NAA and triacontanol caused a favourable influence on the growth of crop when freezing temperature occurred during the growing period of fenugreek. It is possible that foliar sprays of plant growth regulators could have resulted in higher production of assimilates which may be due to greater photosynthetic efficiency, which ultimately could have led to increase in growth and development (Fattah *et al.* 1998).

Significant increase in plant height, branches plant^{-1}, dry matter accumulation, chlorophyll content, number and dry weight of root nodules plant^{-1} of fenugreek crop was observed with increasing levels of Zn up to 4 kg ha^{-1} (Table 1). The favourable influence of applied Zn on these growth parameters may be ascribed to catalytic

Table 1. Influence of plant growth regulators (PGRs) and zinc levels on growth attributes of fenugreek

Treatments	Plant stand		Plant height (cm)			Branches plant^{-1}		Dry matter accumulation (g)			No. of root nodules	Dry weight of root nodules	Chlorophyll content (mg g^{-1})
	30 DAS	At harvest	45 DAS	90 DAS	At harvest	90 DAS	At harvest	45 DAS	90 DAS	At harvest			
PGRs													
Triacontanol	10.82	10.86	9.98	47.04	62.06	6.5	8.3	11.43	70.69	109.8	7.9	36.9	2.79
NAA	10.75	10.65	9.60	46.99	61.31	6.2	7.8	11.20	67.25	105.2	7.4	36.3	2.60
Thiourea	10.77	10.56	9.53	43.08	57.05	5.8	7.0	10.92	62.45	98.35	6.9	34.4	2.38
Control	10.41	10.27	9.08	39.83	52.40	5.2	5.7	10.28	57.48	90.99	6.4	32.2	2.00
Zinc (kg ha^{-1})													
0	10.55	10.45	9.15	40.11	52.30	5.1	5.6	10.12	57.13	92.12	6.2	32.1	1.95
2	10.68	10.49	9.40	43.34	56.83	5.8	6.9	10.78	63.16	98.88	7.1	34.3	2.36
4	10.70	10.60	9.60	46.57	61.17	6.3	7.9	11.32	68.27	105.9	7.6	36.3	2.65
6	10.82	10.80	10.04	46.92	62.52	6.5	8.3	11.62	69.31	107.9	7.7	37.0	2.81
SEm±	0.27	0.27	0.23	1.08	1.44	0.16	0.20	0.24	1.56	2.28	0.16	0.67	2.06
CD (P<0.05)	NS	NS	NS	3.10	4.15	0.46	0.58	NS	4.48	6.28	0.47	1.93	0.19

NS=Non significant; DAS=Days after sowing

or stimulating effect of Zn on most of the physiological and metabolic processes of the plant. Zn is a component of chlorophyll and it plays an important role in N metabolism, resulting in increase uptake of N by the plants. Zn has also been reported to play an important role in regulating the auxin concentration in plants. Thus application of Zn in a soil with Zn deficiency would have improved the overall growth attributes (Narolia 2004).

Foliar application of NAA and triacontanol significantly enhanced the N, P, Zn concentration and their uptake in seed and straw and also protein content in seed (Table 2). The quantum of nutrient uptake by the crop is dependent on extent of biomass production and concentration of nutrient at cellular level. Since concentration of nutrients are improved by application of PGRs, the total biomass production is primarily responsive for the quantum of nutrient uptake. The increase in protein content was due to its direct correlation with the N concentration. The results of present experiment are in close conformity with the findings of Nehara *et al.* (2006).

A significant increase in N concentration in both seed straw and protein content in seed of fenugreek was recorded with increasing levels of Zn up to 4 kg ha^{-1} (Table 2). Higher availability of N under Zn treatments may be due to their synergetic effect. As both the N concentration in seed and straw and their respective yield were increased, it can be said that the total uptake of N also increased significantly with the application of Zn. Similar results have been reported by Narolia (2004). Phosphorus concentration in seed and straw decreased with increasing levels of Zn up to 6 kg ha^{-1} (Table 2). The uptake of P due to application of Zn increased significantly at lower levels of Zn (2 kg ha^{-1}) but thereafter, increase was non-significant. The results are in agreement with Pathak *et al.* (2003). Application of Zn with increasing levels up to 6 kg ha^{-1} lead to increase in Zn concentration in seed and straw and its uptake (Table 2). The beneficial role of Zn in increasing CEC of roots is known, which may have helped in increased

Table 2. Influence of plant growth regulators and zinc levels on quality attributes of fenugreek

Treatments	N concentration (%)		P concentration (%)		Zn concentration (ppm)		Protein content (%)	Total N uptake (kg ha^{-1})	Total P uptake (kg ha^{-1})	Total Zn uptake (g ha^{-1})
	Seed	Straw	Seed	Straw	Seed	Straw				
*PGRs*Triacontanol	3.56	0.914	0.476	0.167	16.25	14.29	22.25	79.68	11.78	66.79
NAA	3.54	0.896	0.473	0.166	15.96	14.14	22.12	77.43	11.57	66.92
Thiourea	3.42	0.859	0.464	0.158	15.05	13.23	21.63	66.59	9.92	55.53
Control	3.01	0.713	0.380	0.141	13.31	10.86	18.81	48.30	7.16	38.59
Zn (kg ha^{-1})										
0.0	2.90	0.714	0.486	0.182	12.33	10.84	18.13	46.14	9.12	37.13
2.0	3.34	0.813	0.460	0.171	14.28	12.68	20.88	65.22	10.58	53.40
4.0	3.58	0.903	0.437	0.148	16.09	14.05	22.38	77.18	10.60	65.88
6.0	3.69	0.953	0.410	0.131	16.96	14.95	23.06	83.46	10.13	73.40
SEm±	0.079	0.019	0.008	0.003	0.32	0.34	0.50	1.70	0.29	2.03
CD (P<0.05)	0.229	0.056	0.023	0.010	0.93	0.98	1.43	4.88	0.84	5.86

absorption of nutrients from the soil including Zn. Similar results were obtained earlier by Choudhary (2006).

From the study, it may be concluded that the significant improvement was observed in growth and quality aspects of fenugreek with foliar spray of 1000 ppm triacontanol at 40 and 60 days after sowing and soil applied with 4 kg Zn ha^{-1}. Based on response studies the optimum dose of Zn was found to be 5.326 kg ha^{-1}.

References

AOAC 1975 Official Methods of Analysis, 12th Ed. Association of Official Agricultural Chemists, Washington DC.

Arnon D I 1949 Copper enzymes in isolated chloroplast polyphenoloxidase in *Beta vulgaris.* Plant Physiol. 24: 1–5.

Choudhary M 2006 Response of clusterbean (*Cynopsis tetragonoloba* L.) to sulphur and zinc fertilization. M.Sc. Thesis, Rajasthan Agricultural University, Bikaner.

Fattah Q A, Habib S, Jahan N & Mondal M R I 1998 Physiological response of niger (*Guizotia abyssinica)* to mixtalol and potassium naphthenate application. Bangladesh J. Bot. 27: 97–102.

Fisher R A 1950 Statistical methods for research workers. Oliver and Boyd. Edinburg, London, pp.57–63.

Lindsay W L & Norwell W A 1978 Development of DTPA soil test for zinc, iron, manganese and copper. Soil Sci. Soc. America J. 42: 421–428.

Narolia G P 2004 Response of isabgol (*Plantago ovata*) to phosphorus, PSB and zinc. M.Sc. Thesis, Rajasthan Agricultural University, Bikaner.

Nehara K C, Kumawat P D & Singh B P 2006 Response of fenugreek (*Trigonella foenum-gracum*) to phosphorus, sulphur and plant growth regulators under semi-arid plains zone of Rajasthan. Indian J. Agron. 51: 73–76.

Pathak S, Namdeo K N, Chakrawati V K & Tiwari R K 2003 Effect of biofertilizers diammonium phosphate and zinc sulphate on growth and yield of chickpea (*Cicer arietinum* L.). Crop Res. 26: 42–46.

Snell C D & Snell C T 1949 Colorometric method of analysis. IIAD Vannostrand Co. Inc., New York.