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EFFECT OF MULTI-MICRONUTRIENT MIXTURE GRADES APPLICATION ON GROWTH AND QUALITY OF SOYBEAN (*GLYCINE MAX*)

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ABSTRACT

An experiment was conducted on loamy sand soil at Tribal Research cum Training Center Farm, Anand Agricultural University, Devgadh Baria, Gujarat during Kharif season of 2022, 2023 and 2024. Eight treatment comprising of RDF and different micronutrient fertilizer grades viz. T_1: RDF (45:60:00 NPK kg/ha), T_2: RDF + Water spray @ 30 and 60 DAS, T_3: RDF + MM Grade I @ 1.0% foliar spray @ 30 and 60 DAS, T_4: RDF + MM Grade II @ 1.0% foliar spray @ 30 and 60 DAS, T_5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS, T_6: RDF + MM Grade IV @ 1.0% foliar spray @ 30 and 60 DAS, T_7: RDF + MM Grade V@ 20 kg/ha (Soil Application) at basal and T_8: RDF +STV (Soil test based application) were tried out in a RBD with four replications. It could be concluded that for securing maximum seed yield and straw yield of Soybean as well as economic returns, Soybean are recommended to apply recommended dose of fertilizer (45:60:00 NPK kg/ha) along with foliar spray of 1 % multi-micronutrient mixture grade-III or IV at 30 and 60 DAS for getting higher yield and net return.

Keywords **:** Soybean (*Glycine max.*), Multi-micronutrient mixture grade.

Introduction

Soybean is an oilseed crop with a large number of cultivars. It is an important global crop providing high (38 - 45%) protein content and high (20%) oil content. Soybean being the richest, cheapest and easiest source of best quality proteins and fats and having a vast multiplicity of uses as food and industrial products is sometimes called a ‘wonder crop’. As it has wide adaptability to climate, soil stress tolerance, instant market at remunerative price, it has played prominent role in rapid spread of soybean in the country. Soybean is first in rank in cultivation in oilseed crops in world and India. Soybean has revolutionized socio-economic status of soya farmers as well as other classes of India. Soybean varies in growth, habit and height. It may grow prostrate, not higher than 20 cm, or grow upto 2 meters in height. The pods, stem and leaves are covered with fine brown or grey hairs. The leaves are trifoliate having 3-4 leaflets per leaf. The leaves fall before the seeds are mature. The big, in cospicuous, selffertile flowers are borne in the axil ofleaves and are white, pink or purple. The fruit is hairy pod in cluster of 3-5. Each pod is 3-8 cm long and usually contains 2-4 seeds. Soybean fruits are in many hull colours like black, blue, yellow, green and mottled.

Soybean is first in rank in cultivation in oilseed crops in world and India. Cultivation of soybean is mainly confined to China, gradually Indonesia, the Philippines, Vietnam, Thailand , Malaysia, Burma, Taiwan, Nepal, India, North America and Europe.

In India, the production of oil seed crops have doubled in 1993 -1994 (21.5 million MT) as compared with 10.8 million MT of 1985–1986 (FAOSTAT, 2013). It is grown in Madhya Pradesh, Uttar Pradesh, Maharashtra, Gujrat, Himachal Pradesh, Punjab and Delhi. With approximately 75 % share in national area and production of soybean in India, Madhya Pradesh has distinguished as 'soya-state.' At present time,

production of soybean of India is 8 - 9 qui / ha while that of world is 22 - 38 qui / ha. In India about 4-25 million hectares land is under soybean cultivation producing about 4.62 million tonnes of soybean. In Maharashtra , 4.60 lakh hectares land is under cultivation of soybean. Despite the spectacular growth in area and production, the average productivity of the crop (1.2 t/ha) in India is less than half the world average (2.53 t/ha) and one third of its climatic potential (3.5 t per ha) (Bhatia *et al*., 2008). Several abiotic, biotic and socio-economic factors, responsible for low productivity of soybean in India have been identified (Paroda, 1999; Bhatia and Joshi, 2003). Due to rainfed nature, occurrence of severe drought conditions at one or the other stages of crop growth and development is the most important factor limiting soybean productivity in India (Bhatia and Joshi, 2003).

In view of this, field trial was carried out on integrated nutrient management of major nutrients viz., N, P and K with along with soil application of Fe or/and Zn or foliar application of Fe or/ and Zn to evaluate the performance of various nutrient. Therefore, essential to provide an effective multi-micronutrient management for Soybean Keeping this in view the present experiment is proposed. Keeping all these factors in view, the present research work will be planned.

Materials and Methods

A field experiment was conducted at Tribal Research cum Training Center Farm, Anand Agricultural University, Devgadh Baria, Gujarat during Kharif season of 2022, 2023 and 2024. The texture of the soil is loamy sand. The soil is very deep and fairly moisture retentive. The soil was low in organic carbon and nitrogen, high in available phosphorus and medium in potassium with pH 7.6. The soil was free from any kind of salinity/sodicity hazards. Eight treatment comprising of RDF and different micronutrient fertilizer grades viz. T_1: RDF (45:60:00 NPK kg/ha), T_2: RDF + Water spray @ 30 and 60 DAS, T_3: RDF + MM Grade I @ 1.0% foliar spray @ 30 and 60 DAS, T_4: RDF + MM Grade II @ 1.0% foliar spray @ 30 and 60 DAS, T_5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS, T_6: RDF + MM Grade IV @ 1.0% foliar spray @ 30 and 60 DAS, T_7: RDF + MM Grade V@ 20 kg/ha (Soil Application) at basal and T_8: RDF +STV (Soil test based application) were tried out in a RBD with four replications.

Biometric Observations

Growth and yield attributing characters

Plant population was recorded at 30 DAS and at harvest time in soybean from each net plot and was worked out and recorded hectare basis. While in case of plant height, the five plants were randomly selected and tagged from each net plot. The height of these plants was recorded at 30 DAS and at harvest from base of the plants to the tip of the upper opened leaf. Average values of height were worked out and recorded for all the treatments.

Number of effective branches per plant from five previously selected and tagged plants was worked out from each net plot at harvest and the mean value was recorded separately. Harvest index is defined as the ratio of economic yield to biological yield and expressed in percentage (Donald and Hablin, 1976). Ratio of seed yield to a biological yield of each net plot was worked out and reported in percentage as harvest index.

$$\text{Harvest Index (\%)} = \frac{\text{Seed yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

In case of crude protein content, the seed samples were drown from all respective plots for analyzing total nitrogen content by Micro-Kjeldahl digestion and distillation method (Jackson, 1973). Then the nitrogen content multiplied with conversion factor of 6.25 to obtain protein content in seeds. Seed yield per plot was recorded after threshing and winnowing the seeds from each net plot area. The seed yield was worked out and expressed in kg/ha. While in case of straw yield, the total biological portion from yield of above ground portion from net plot at harvest was recorded after complete sun drying and straw yield (kg/ha) was worked out by deducting the grain yield.

Statistical Analysis

The data of various growth, yield and quality parameters were subjected to statistical analysis as per statistical method appropriate to Randomized Block Design explained by Cochran and Cox (1967). The analysis carried out with the help of computer system at the Computer Center, Department of Agricultural Statistics, BACA, AAU, Anand. Variance of different sources were evaluated by “F-test” then the value of calculated “F’’ was compared with the value of table F at 5% level of significance. The values of S.Em. ±, C. D. and C.V.% were also worked out. These values are given in chapter “experimental results” and the analysis of their variance is given in the appendices.

Economics

The relative economics of each treatment was evaluated to assess the most beneficial and remunerative treatment. The gross realization was worked out on the basis of their prevailing market prices in terms of rupees per hectare for each respective treatment. In the same way, the cost of cultivation from tillage to harvesting including threshing, winnowing and cost of inputs viz., seeds and fertilizers was also calculated. To obtain net income per hectare the total cost of cultivation deducted from the gross realization for each respective treatment and recorded accordingly. Thus the benefit cost ratio (BCR) was calculated by using the below given formula.

$$BCR = \frac{\text{Gross realization (Rs/ha)}}{\text{Total cost of cultivation (Rs/ha)}}$$

Table 1: Micronutrient content in different types of grades

Grade	Amount of micronutrient (%)				
	Fe	**Mn**	**Zn**	**Cu**	**B**
For the spray					
Multi micronutrient Grade I (General grade)	2.0	0.5	4.0	0.3	0.5
Multi micronutrient Grade II (for iron deficiency)	6.0	1.0	4.0	0.3	0.5
Multi micronutrient Grade III (for zinc deficiency)	2.0	0.5	8.0	0.5	0.5
Multi micronutrient Grade IV (for zinc and iron deficiency)	4.0	1.0	6.0	0.5	0.5
For soil application					
Multi micronutrient Grade V (General grade)	2.0	0.5	5.0	0.2	0.2

Table 2: Plant population of Soybean as influenced by different treatments

Treatments	Plant population							
	At 30 DAS				At Harvest			
	2022	**2023**	**2024**	**Pooled**	**2022**	**2023**	**2024**	**Pooled**
T_1: RDF (45:60:00 NPK kg/ha)	338	373	360	357	337	372	355	354
T_2: RDF + Water spray @ 30 and 60 DAS	340	375	358	357	335	370	353	352
T_3: RDF + MM Grade I @ 1.0% foliar spray @ 30 and 60 DAS	346	381	364	364	340	375	358	358
T_4: RDF + MM Grade II @ 1.0% foliar spray @ 30 and 60 DAS	345	380	363	362	342	377	360	359
T_5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS	344	379	362	362	341	376	359	359
T_6: RDF + MM Grade IV @ 1.0% foliar spray @ 30 and 60 DAS	346	381	364	364	343	378	361	361
T_7: RDF + MM Grade V@ 20 kg/ha (Soil Application) at basal	345	380	363	363	342	377	360	360
T_8: RDF +STV (Soil test based application)	343	378	361	360	341	376	359	358
S.Em.+	9.24	10.65	11.54	6.07	8.70	10.23	10.83	5.75
C.D @ 5 %	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Year (Y)								
S.Em.±	-	-	-	**3.7**	-	-	-	**3.5**
C.D @ 5 %	-	-	-	**NS**	-	-	-	**NS**
Y x T								
S.Em.±	-	-	-	**10.5**				**10.0**
C.D @ 5 %	-	-	-	**NS**	-	-	-	**NS**
C.V. %	**5.38**	**5.63**	**6.38**	**5.83**	**5.12**	**5.46**	**6.05**	**5.57**

Table 3 : Plant height and No. of branches/plant of Soybean as influenced by different treatments

Treatments	Plant height (cm)								No. of branches/plant			
	At 30 DAS				At Harvest							
	2022	2023	2024	Pooled	2022	2023	2024	Pooled	2022	2023	2024	Pooled
T_1: RDF (45:60:00 NPK kg/ha)	19.60	25.00	22.70	22.43	52.25	56.25	53.60	54.03	3.53	3.93	3.73	3.73
T_2: RDF + Water spray @ 30 and 60 DAS	18.65	24.08	21.78	21.50	51.80	55.80	53.90	53.83	3.60	3.99	3.79	3.80
T_3: RDF + MM Grade I @ 1.0% foliar spray @ 30 and 60 DAS	19.05	24.45	22.15	21.88	53.70	57.70	55.80	55.73	3.68	4.09	3.89	3.89
T_4: RDF + MM Grade II @ 1.0% foliar spray @ 30 and 60 DAS	19.30	24.70	22.40	22.13	50.15	54.15	52.25	52.18	3.50	3.90	3.70	3.70
T_5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS	19.60	25.00	22.70	22.43	57.60	61.60	59.70	59.63	4.43	4.83	4.63	4.63
T_6: RDF + MM Grade IV @ 1.0% foliar spray @ 30 and 60 DAS	19.88	25.28	22.98	22.71	56.25	60.25	58.35	58.28	3.83	4.55	4.35	4.24
T_7: RDF + MM Grade V@ 20 kg/ha (Soil Application) at basal	20.25	25.65	23.35	23.08	52.55	56.55	54.65	54.58	4.15	4.23	4.03	4.14
T_8: RDF +STV (Soil test based appli.)	19.88	25.28	22.98	22.71	56.50	60.50	58.60	58.53	3.89	4.29	4.09	4.09
S.Em.+	0.62	0.80	0.82	0.43	1.67	1.71	1.72	0.98	0.15	0.16	0.16	0.09
C.D @ 5 %	**NS**	**NS**	**NS**	**NS**	**4.91**	**5.04**	**5.05**	**2.78**	**0.43**	**0.48**	**0.47**	**0.26**
Year (Y)												
S.Em.±	-	-	-	**0.30**	-	-	-	**0.6**	-	-	-	**0.10**
C.D @ 5 %	-	-	-	**NS**	-	-	-	**NS**	-	-	-	**NS**
Y x T												
S.Em.±	-	-	-	**0.8**	-	-	-	**1.70**	-	-	-	**0.20**
C.D @ 5 %	-	-	-	**NS**	-	-	-	**NS**	-	-	-	**NS**
C.V. %	**6.33**	**6.44**	**7.24**	**6.73**	**6.20**	**5.92**	**6.15**	**6.09**	**7.65**	**7.70**	**7.96**	**7.76**

Table 4 : Seed yield, straw yield, HI and Crude Protein Content of Soybean as influenced by different treatments

Treatments	Seed yield (Kg/ha)				Straw yield (Kg/ha)				HI (%)	Crude Protein Content (%)
	2022	2023	2024	Pooled	2022	2023	2024	Pooled		
T_1: RDF (45:60:00 NPK kg/ha)	1772	1601	1643	1672	1887	1686	1865	1813	46.09	40.41
T_2: RDF + Water spray @ 30 and 60 DAS	1854	1756	1800	1803	1971	1920	1974	1955	46.50	38.76
T_3: RDF + MM Grade I @ 1.0% foliar spray @ 30 and 60 DAS	1876	1780	1822	1826	2045	1944	1998	1995	47.84	39.75
T_4: RDF + MM Grade II @ 1.0% foliar spray @ 30 and 60 DAS	1925	1829	1871	1875	2098	1997	2051	2049	47.00	39.81
T_5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS	**2183**	**2062**	**2104**	**2117**	**2351**	**2247**	**2304**	**2301**	48.13	39.52
T_6: RDF + MM Grade IV @ 1.0% foliar spray @ 30 and 60 DAS	**2078**	**1982**	**2024**	**2028**	**2265**	**2164**	**2218**	**2215**	48.00	38.88
T_7: RDF + MM Grade V@ 20 kg/ha (Soil Application) at basal	1972	1876	1918	1922	2150	2049	2103	2100	47.84	40.16
T_8: RDF +STV (Soil test based application)	1853	1782	1825	1820	2023	1947	1876	1949	48.14	38.47
S.Em.+	83.28	86.69	83.73	48.83	94.64	101.71	97.64	56.60	0.08	0.56
C.D @ 5 %	**245**	**255**	**246**	**138**	**278**	**299**	**287**	**160**	0.25	**NS**
Year (Y)										
S.Em.±	-	-	-	29.9	-	-	-	34.7	**0.22**	**0.30**
C.D @ 5 %	-	-	-	**NS**	-	-	-	**NS**	**NS**	**NS**
Y x T										
S.Em.±	-	-	-	84.6	-	-	-	98.0	**0.79**	**0.8**
C.D @ 5 %	-	-	-	**NS**	-	-	-	**NS**	**NS**	**NS**
C.V. %	**8.59**	**9.46**	**8.93**	**8.98**	**9.02**	**10.20**	**9.53**	**9.58**	**3.05**	**4.96**

Table 5 : Economics of Soybean as influenced by different treatments

Treatments	Seed Yield (Kg/ha)	Straw Yield (Kg/ha)	Gross Realization (Rs./ha)	Total Cost of cultivation (Rs./ha)	Net Realization (Rs./ha)	BCR
T_1: RDF (45:60:00 NPK kg/ha)	1672	1813	83882	29338	54544	1.86
T_2: RDF + Water spray @ 30 and 60 DAS	1803	1955	90454	29621	60833	2.05
T_3: RDF + MM Grade I @ 1.0% foliar spray @ 30 and 60 DAS	1826	1995	91638	30037	61601	2.05
T_4: RDF + MM Grade II @ 1.0% foliar spray @ 30 and 60 DAS	1875	2049	94098	30156	63942	2.12
T_5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS	2117	2301	106218	30103	76115	2.53
T_6: RDF + MM Grade IV @ 1.0% foliar spray @ 30 and 60 DAS	2028	2215	101774	30077	71697	2.38
T_7: RDF + MM Grade V@ 20 kg/ha (Soil Application) at basal	1922	2100	96456	30182	66274	2.20
T_8: RDF +STV (Soil test based application)	1820	1949	91258	29338	61920	2.11

Soybean selling Price: 49.0 Rs/kg, Straw Price: 2.0 Rs/kg

Results and Discussion

Effect of treatments on growth and quality of Soybean

The results indicated that the plant stand at 30 DAS and at harvest due to application of different multi-micronutrient mixture grades were found non-significant during the year 2022, 2023, 2024 and on pooled analysis. The results indicated that the plant height at 30 DAS due to application of different multi-micronutrient mixture grades were also found non-significant during the year 2022, 2023, 2024 and on pooled analysis. Where as the result of the pooled analysis in the plant height at harvest showed significant difference through effect of multi-micronutrient mixture grades application on growth, yield and quality of Soybean. Significantly taller plants 59.63 cm were found in treatment T5 - RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS which was remained at par with treatment T6 - RDF + MM Grade IV @ 1.0 % foliar spray @ 30 and 60 DAS (58.28 cm).

The response of the different treatments on number of branches per plant of soybean was found significant during pooled analysis. The highest numbers of branches (4.63) were found under treatment T5 - RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS which was remained at par with treatment T6 - RDF + MM Grade IV @ 1.0 % foliar spray @ 30 and 60 DAS (4.24 cm).

Data on harvest index (%) as influenced by different treatments are presented in Table 4. Effect of multi-micronutrient mixture grades application on growth, yield and quality of Soybean were found significant influence on the harvest index recorded at harvest was found significant during pooled analysis. The highest harvest index (48.13) were found under T5 - RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS which was remained at par with treatment T6 - RDF + MM Grade IV @ 1.0 % foliar spray @ 30 and 60 DAS (48.00 cm). The significantly higher harvest index is due to increased physiological capacity for mobilization and translocation of photosynthates to organs of economic value and improved seed setting as well as seed filling due to boron application (Maghsud *et al*., 2014 and Seyedeh and Seyyed, 2017)

Effect of multi-micronutrient mixture grades application on growth, yield and quality of Soybean were found non-significant influence on the Crude Protein Content (%) recorded at harvest during the year 2022, 2023, 2024 and in pooled analysis.

Data pertaining to seed yield and straw yield (kg/ha) of soybean for the years 2022, 2023, 2024 and pooled analysis as influenced by different treatments were found significant. The results revealed that the effect of multi-micronutrient mixture grades application on growth, yield and quality of Soybean were found significant influence of seed yield during the year 2022, 2023, 2024 and in pooled analysis. Treatment T5 - RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS was recorded significantly higher seed yield (2183, 2062, 2107 and 2117 kg/ha) which was remained at par with treatment T6 - RDF + MM Grade IV @ 1.0 % foliar spray @ 30 and 60 DAS (2078, 1982, 2024 and 2028 kg/ha) than rest of the treatment during three years and in pooled analysis. The lowest soybean seed yield (1772, 1601, 1643 and 1672 kg/ha) was noted with treatment T1: RDF (45:60:00 NPK kg/ha). This is due to increase in growth attributes and enhanced synthesis of carbohydrates and proteins and their transport to the site of seed formation as zinc takes part in the metabolism of plant as an activator of several enzymes,

which in turn can directly or indirectly affect the synthesis of carbohydrates and proteins. These are results agreed with Ravi *et al*. (2008) and Singh and Singh (2005).

The results revealed that the effect of multi-micronutrient mixture grades application on growth, yield and quality of Soybean were found significant influence of straw yield during the year 2022, 2023, 2024 and in pooled analysis. Treatment T_5 - RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS was recorded significantly higher seed yield (2351, 2247, 2304 and 2301 kg/ha) which was remained at par with treatment T_6 - RDF + MM Grade IV @ 1.0 % foliar spray @ 30 and 60 DAS (2265, 2164, 2218 and 2215 kg/ha) than rest of the treatment during three years and in pooled analysis. The lowest soybean straw yield (1887, 1686, 1865 and 1813 kg/ha) was noted with treatment T_1: RDF (45:60:00 NPK kg/ha).

Economics

The data on gross and net realization as well as BCR are presented in Table 5. Among the different treatments, treatment T5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS recorded maximum net realization of Rs. 76115/ha followed by Rs. 71697 in treatment T6: RDF + MM Grade IV @ 1.0% foliar spray @ 30 and 60 DAS. The highest value of BCR was obtained under treatment T5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS 1: 2.53 followed by treatment T5: RDF + MM Grade III @ 1.0% foliar spray @ 30 and 60 DAS 1: 2.38. The increase in profit was mainly due to more seed yield and straw yield of soybean. Similar results were found by Babhulkar *et al*. (2000), Bameri et.al (2012) and Wojtkowiak (2015).

Conclusion

In view of results obtained from the present investigation, it could be concluded that, Soybean are recommended to apply recommended dose of fertilizer (45:60:00 NPK kg/ha) along with foliar spray of 1 % multi-micronutrient mixture grade-III or IV at 30 and 60 DAS for getting higher yield and net return.

References

Babhulker, P.S., Kar, D., Badole, W.P., Balpande, S.S. (2000). Effect of sulphur and zinc on yield, quality and nutrient uptake by safflower in Vertisol. *J Indian Soc. Soil Sci*., **48**(3):541-543.

Bameri, M., Abdolshahi, R., Mohammadi, N.G., Yousefi, K., Tabatabaie, S.M. (2012). Effect of different microelement treatment on wheat (*Triticum aestivum*) growth and yield. *Int. Res. J Appl. Basic Sci*. **3**(1): 219-223.

Bhatia, V.S., Yadav, S., Rashmi, A., Lakshmi, N. and Guruprasad, K.N. (2003). Assessment of photoperiod sensitivity for flowering in Indian soybean varieties. *Indian Journal of Plant Physiology*, (Special Issue): 81-4.

Bhatia, V.S., Singh, P., Wani, S.P., Chauhan, G.S., Rao, A.V.R.K., Mishra, A.K. and Srinivas, K.S. (2008). Analysis of potential yields and yield gaps of rainfed soybean in India using CROPGRO-Soybean model. *Agriultural and Forest Meteorology*, 148: 1252-65.

Cochran, W.G. and Cox, G.M. (1967). *Experimental Designs*. John Willey and Sons. Inc. New York, 546-68.

Donald, C.M. and Hamblin, J. (1976). The biological yield and harvest index of cereals as agronomic and plant breeding criteria. *Advances in Agronomy*, 28, 361-364.

FAOSTAT. (2013). http://faostat.fao.org/

Jackson, M.L. (1973). "Soil chemical analysis". Prentice Hall India Pvt. Ltd., New Delhi, 183-192.

Maghsud, S.G., Mobasser, H.R., Fanaei, H.R. (2014). Effect of foliar application and time of foliar application microelements (Zn, Fe, Mn) on safflower. *J Novel Appl. Sci*., **3**: 396-399.

Paroda, R.S. (1999). Status of soybean research and development in India. In: Kauffman, H E (Ed.), Proceedings of VI World Soybean Research Conference, Chicago, IL, USA, pp. 13–23.

Ravi, S., Channal, H.T., Hebsur, N.S., Patil, B.N., Dharmatti, P. (2008). Effect of sulphur, zinc and iron nutrition on growth, yield, nutrient uptake and quality of Safflower. *Karnataka J. Agric. Sci*., **21**(3): 382-385.

Seyedeh, M., Majid, M., Seyyed, M.E. (2017). Evaluation of iron and zinc foliar and soil application on quantitative and qualitative characteristics of two soybean cultivars. *Institute of Integrative Omics App. Biotech. J*., **8**(3):1-7.

Singh, S.P., Singh, V. (2005). Effect of nitrogen, sulphur and zinc on Indian mustard (*Brassica juncea*). *Indian J Agric. Sci*., **75**(12): 828-830.

Wojtkowiak, K., Stępień, A., Warechowska, M., Markowska, A. (2015). Effect of nitrogen fertilization method on the yield and quality of Milewo variety spring triticale seed. *Pol. J. Natur. Sci*. **30**(2):173-184.