The Pharma Innovation Journal 2023; 12(11): 907-911

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(11): 907-911

www.thepharmajournal.com
Received: 02-08-2023
Accepted: 19-10-2023

Snehil Kumar Watsh
M.Sc. Scholar, Department of Agronomy, SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

AC Shivran
Professor, Department of Agronomy, SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Manisha Kumawat
M.Sc. Scholar, Department of Agronomy, SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Sachin Kumar Pradhan
M.Sc. Scholar, Department of Soil Science, SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

BL Dudwal
Assistant Professor, Department of Agronomy, SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Corresponding Author:
Snehil Kumar Watsh
M.Sc. Scholar, Department of Agronomy, SKN College of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Effect of sulphur levels and foliar application of liquid manures on growth and yield of sesame

Snehil Kumar Watsh, AC Shivran, Manisha Kumawat, Sachin Kumar Pradhan and BL Dudwal

Abstract
A field experiment was conducted to study the effect of different levels of sulphur and foliar application of liquid manures on growth and yield of sesame at Agronomy farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during *kharif* season 2022. The experiment consisted of sixteen treatment combinations with four levels of sulphur (0, 20, 40 and 60 kg/ha) in factor "A" and four treatments liquid manures *viz*., control, panchgavya, vermiwash and matka khad in factor "B", which were replicated three times in Factorial Randomised Block Design.

Results showed that different levels of sulphur brought significant change in growth and yield of sesame. Significantly higher plant height and dry matter accumulation at different growth stages, number of capsules per plant, number of seeds per capsule, test weight, seed, stalk and biological yields of sesame were recorded under the treatment 40 kg sulphur/ha over control and 20 kg sulphur/ha and it remained at par with the treatment 60 kg sulphur/ha. However, the highest chlorophyll content was found with the application of 60 kg sulphur/ha.

The experimental findings further revealed that the application of liquid manures significantly improved the growth and yield of sesame. The application of panchgavya significantly produced higher plant height, dry matter accumulation, number of capsules per plant, number of seeds per capsule, test weight, seed, stalk and biological yields of sesame over control and Matka Khad but remained statistically equivalent to vermiwash.

Keywords: Oilseed, sesame, sulphur, panchgavya, vermiwash, Matka Khad, growth and yield

Introduction

Oilseeds are one of the major crops cultivated in the country aside from cereals. In terms of area, productivity and economic worth, these crops are second to food grains. India is growing all the major annual oilseed crops and is the world's leading producer of minor oilseeds (Castor, safflower and sesame). *Sesamum indicum* (L.) is an important oilseed crop of the sub-tropical and tropical region, popularly known as "Til" or **"**Gingelly"**.** It is also referred as the "queen of oilseed crops" and was among the earliest oils that people knew about and used (Shelke *et al*., 2014) [21].

It is an edible oil seed crop, akin to groundnut and rapeseed-mustard. Its seed contain about 50-52 per cent oil, 17-19 per cent protein, 0.1-0.5 per cent fatty acid and 16-18 per cent carbohydrates (Kahyaoglu and Kaya, 2006) [9]. Sesame cake or meal, a byproduct of the oil milling enterprise is high in carbohydrates, vitamin (niacin) and minerals including Ca and P. It is mostly used as cattle feed, particularly for milch animals (Balasubramaniyan and Palaniappan, 2001) [3].

The crop covered 2.90 lakh hectares and produced 0.77 lakh tonnes with a productivity of 265 kg/ha in Rajasthan (Anonymous, 2021-22) [1]. Despite of being such an important sesame growing state, the average productivity is very low in comparison to global (545.85 kg/ha) as well as national (485 kg/ha). Cultivation of crop on marginal and sub-marginal lands of poor fertility under rainfed condition, low rainfall, poor agronomic practices and inadequate or even no use of fertilizers are the major factors responsible for low productivity.

Sulphur is an essential nutrient for plant growth and crop production. It is a secondary macronutrient, meaning that it is needed in relatively large quantities compared to micronutrients like iron, zinc or manganese. Sulphur plays a critical role in many plant processes, including protein synthesis and photosynthesis. Sulphur is required for the synthesis of metabolites like coenzyme A, biotin, thiamine or vitamin B_1, glutathione, glycosides and glucosinolates.

It plays an important role in the plant metabolism, indispensable for the synthesis of essential oils and chlorophyll formation and required for development of cells. It also provides cold resistance and drought hardiness to oilseed crops (Patel and Shelke, 1995) [13]. It is also imperative for the health and structure of soil, helping to maintain its pH and fertility (Jamal *et al*., 2010) [7].

The health of the soil and plants has been negatively impacted by conventional agriculture. In order to promote crop establishment and health, it is urgently necessary to limit the use of chemical fertilizers and pesticides in agriculture. As a result, organic farming becomes increasingly popular in order to preserve the health of the land and plants. Foliar application of fertilizers is crucial for increasing crop output and productivity since desert soils are both hungry and thirsty. Therefore, finding an appropriate fertilizer for foliar application that might increase crop quantity and quality may require further investigation.

Panchgavya is an inexpensive organic solution derived from cow products like dung, urine, milk, curd and ghee. Bio-chemical properties of panchgavya revealed that it possesses almost all the major nutrient like NPK, micro nutrients necessary for plant and plant growth hormones like IAA and GA as well as the predominance of fermentative microorganisms like yeast, *Azotobacter*, phosphobacteria and lactobacillus (Praneeth *et al.,* 2021) [16]. Vermiwash is an organic fertilizer decoction obtained from units of vermiculture or vermicompost as drainage. It contains excretory products of earthworm, the worm coelomic fluid oozing through dorsal pores, mucus, enzymes secreted by worm, microorganisms, plant nutrients, vitamins and plant growth promoting substances and its collection of excretion called vermicasts (Ansari, 2008) [2]. Matka khad is an organic product used in agricultural crops to enhance the plant growth by supplying growth stimulators and various nutrients. Microbial analysis of the Matka khad indicated a higher count of microbial population including *Azotobacter*, actinomycetes and phosphate solubilizers which result in higher growth and yield (Chadha *et al*., 2012) [4].

Materials and Methods

The experiment was conducted at Agronomy Farm, S.K.N. College of Agriculture, Jobner (Rajasthan) on field number-10B during *kharif*, 2022. Geographically, Jobner is situated 45 km west of Jaipur at 26º05' N latitude and 75º28' E longitude and at an altitude of 427 metres above mean sea level. The region falls under agro-climatic zone-III A (Semi-arid Eastern Plain Zone) of Rajasthan. The maximum and minimum temperatures during the crop season ranged between 30.2 ℃ to 35.2 ℃ and 16.8 ℃ to 23.0 ℃, respectively. A total of 479.5 mm rainfall was recorded during the cropping season. The relative humidity fluctuated between 41 to 70 per cent, while the average sunshine hours ranged between 2.9 to 9.3 hrs/day. The soil of the experimental field was loamy sandy in texture, alkaline in reaction (pH 8.15), poor in organic carbon (2.05 g/kg) with low available nitrogen (128.80 kg/ha), medium available phosphorus (19.30 kg/ha), potassium (162.85 kg/ha) and sulphur concentration (10.14 ppm).

The field experiment comprising of 16 treatments (4 sulphur levels *viz*., 0, 20, 40 and 60 kg/ha and 4 liquid manures *viz*., *viz*., control, panchgavya, vermiwash and matka khad) was laid out in Factorial Randomized Block Design with three replications. The seed of sesame variety RT-351 @ 4 kg/ha was sown at spacing of 30 cm × 10 cm row to row and plant to plant respectively. Before sowing sulphur was added through gypsum fertilizer according to the treatment level (0, 20, 40 and 60 kg/ha) in assigned plot and incorporated into soil manually. According to the treatment details, spraying of liquid manures *viz*., panchgavya, vermiwash and matka khad @ 3 per cent, 10 per cent and 10 per cent, respectively with water 600 l/ha was done twice first at 30 DAS and second at 60 DAS. Growth attributes such as plant height, dry matter content, number of branches/plant, chlorophyll content and yield attributes includes number of capsules/plant, number of seeds/capsule, test weight and yield (seed, stalk and biological yield) were taken at different growth stages of crop.

Results and Discussions

Growth attributes

A critical examination of data in table 1 to 5 revealed that effect of different levels of sulphur and foliar application of liquid manures was found significant on growth attributes of sesame.

Sulphur levels: At the majority of the stages of observation, the sesame crop responded favourably to sulphur levels in terms of plant height, dry matter accumulation, number of branches per plant and chlorophyll content. Application of 40 kg sulphur/ha recorded significantly higher plant height (23.41 cm), (111.22 cm) and (133.54 cm) and dry matter accumulation (16.96 g), (84.48 g) and (100.57 g) at 30 DAS, 60 DAS and harvest, respectively and number of branches per plant (2.95) at 50 DAS and (3.37) at harvest and chlorophyll content recorded significantly highest (2.72 mg/g) at 40 DAS under the application of sulphur @ 60 kg/ha over rest of the treatments. The observed improvement might be due to the early and abundant availability of sulphur, which results in a better nutritional environment in the root zone for growth and development. Sulphur is a secondary essential plant nutrient that is necessary for growth. It appears to have significantly stimulated vegetative growth of crops in terms of dry matter accumulation and plant height by activating a number of enzymes involved in the dark reaction of photosynthesis via general improvement and their activation at the cellular level by promoting greater photosynthesis and merismetic activity. Results of the present investigation are in cognizance with the findings of Jat *et al.* (2017) [8], Parmar *et al*. (2018) [12] and Paul *et al.* (2019) [15] in sesame.

liquid manures: The numerous growth parameters of sesame, including plant height, number of branches per plant, accumulation of dry matter and chlorophyll content, were all significantly increased with the foliar application of several liquid manures. Two foliar sprays of panchgavya at 30 and 60 DAS, recorded significantly higher plant height (108.21 cm) and (130.06 cm) and dry matter accumulation (87.62 g) and (105.53 g) at 60 DAS and harvest, respectively over control and matka khad, but remained at par with two sprays of vermiwash. Furthermore, two sprays of panchgavya achieved the maximum number of branches per plant (3.00) at 50 DAS and (3.37) harvest and chlorophyll content (2.50 mg/g) at 40 DAS, which was statistically equivalent to two sprays of vermiwash and matka khad but significantly higher over the control. The role that these liquid manures play in supplying nutrients to the crops as described earlier by Munji *et al.*

(2010) [11] in sesame could be responsible for the observed improvement in growth qualities under the impact of these manures. Vermiwash, a foliar spray that contains a combination of mucus secretions, earthworm excretory products, several micronutrients from soil molecules, nitrogen, growth-regulating hormones and vital enzymes like protease, amylase, phosphatase and urease, promotes plant growth and development. It can be correlated with the findings of Rekha *et al.* (2013) [18] in black gram and Yadav *et al.* (2017) [23] in chickpea. Matka khad enhance the plant growth by supplying growth stimulators and various nutrients. Microbial analysis of the matka khad indicated higher count of microbial population including *Azotobacter*, actinomycetes and phosphate solubilizers. It has been reported earlier by Rameshwar *et al.* (2011) [17]. It is well known that panchgavya contains a variety of advantageous microorganisms, including *Azotobacter*, *Azospirillum*, phosphobacteria and pseudomonas, which support a variety of plant growth characteristics. Ample amounts of growth-regulating substances like IAA, GA and cytokinin are also present in panchgavya. These traits favour rapid cell division and multiplication. Similar findings were also reported by Patil *et al.* (2012) [14] and Yadav *et al.* (2017) [23] in black gram.

Yield attributes and yield

The experimental findings presented in table 1 and 5 revealed that effect of different levels of sulphur and foliar application of liquid manures on yield attributes and yield of sesame.

sulphur levels: According to the results regarding the number of capsules per plant, number of seeds per capsule, test weight, seed yield, stalk yield and biological yield, application of various levels of sulphur was significantly more effective than the control in increasing yield attributes and yield of sesame. The results showed that the significantly higher number of capsules per plant (27.9), number of seeds per capsule (38.4), test weight (2.68 g) seed yield (7.57 q/ha), stalk yield (22.93 q/ha) and biological yield (30.49 q/ha) were obtained with an application of 40 kg sulphur/ha. However, 60 kg of sulphur/ha was found to be statistically similar to 40 kg sulphur/ha. The significant increase in test weight and capsules per plant that resulted from the application of sulphur might be due to a general improvement in crop vigour and growth, as evidenced by plant height, accumulation of dry matter and number of branches per plant. Another potential explanation for the improvement in yield-determining characteristics of sesame could be more assimilate partitioning as well as appropriate supply and translocation of metabolites and nutrients towards reproductive structures (*i.e.* sink) corresponding to their demand for growth and development. It can be correlated with the findings of Mathew *et al.* (2012) [10] and Venkatakrishnan *et al.* (2020) [22] in sesame. The significant increase in seed yield was primarily the result of better growth, which led to an increase in various yield attributes, as a result of S fertilisation. The biological yield depends on the stalk and seed yields. As a result of improvements in seed and stalk yields, there has been a large increase in biological yield. Further, higher nutrient uptake and better use of radiant energy led to higher vegetative and reproductive growth, thus enhancing biological yield in presence of sulphur. Similar findings were also reported by Shah *et al.* (2013) [19], Jat *et al.* (2017) [8], Paul *et al.* (2019) [15] and Yadav *et al.* (2020) [24] in sesame.

liquid manures: The results for number of capsules per plant, number of seeds per capsule, test weight, seed yield, stalk yield and biological yield showed that foliar application of various liquid manures was significantly more effective than control in increasing sesame yield attributes. The findings demonstrated that two panchgavya foliar sprays at 30 DAS and 60 DAS recorded the higher number of capsules per plant (28.4), seeds per capsule (38.6) and test weight (2.77 g). However, vermiwash application was shown to be significantly similar with panchgavya. Similar research findings were also reported earlier by Munji *et al.* (2010) [11], Shariff *et al.* (2017) [20], Yadav *et al.* (2017) [23] and Chandra and Mehra (2022) [5] in sesame, green gram, chickpea and ground nut, respectively. Two sprays of panchgavya at 30 DAS and 60 DAS recorded significantly higher seed yield (7.76 q/ha), stalk yield (23.52 q/ha) and biological yield (31.28 q/ha) followed by two sprays of vermiwash as compared to control and matka khad. These results can be correlated with research findings of Munji *et al.* (2010) [11], Devakumar *et al.* (2014) [6], Shariff *et al.* (2017) [20] and Yadav *et al.* (2017) [23] in sesame, maize, green gram and chickpea, respectively.

Table 1: Effect of sulphur fertilization and foliar application of liquid manures on plant height at different growth stages of sesame

Treatment	Plant height (cm)		
	30 DAS	60 DAS	At harvest
Sulphur levels (kg/ha)			
Control	18.19	79.98	100.05
20	19.94	100.91	120.37
40	23.41	111.22	133.54
60	25.06	117.12	138.54
S.Em+	0.60	2.33	2.72
CD (P=0.05)	1.73	6.73	7.87
Liquid manures			
Control	21.49	94.65	114.24
Panchgavya	21.74	108.21	130.06
Vermiwash	21.82	104.91	126.07
Matka khad	21.55	101.45	122.13
S.Em+	0.60	2.33	2.72
CD (P=0.05)	NS	6.73	7.87
CV (%)	9.60	7.89	7.66

Table 2: Effect of sulphur fertilization and foliar application of liquid manures on dry matter accumulation at different growth stages of sesame

Treatment	Dry matter accumulation (g/m row length)		
	30 DAS	60 DAS	At harvest
Sulphur levels (kg/ha)			
Control	14.18	66.97	79.66
20	15.59	77.49	93.21
40	16.96	84.48	100.57
60	17.39	86.69	103.89
S.Em+	0.46	1.98	2.14
CD (P=0.05)	1.34	5.72	6.17
Liquid manures			
Control	16.01	65.71	79.15
Panchgavya	16.09	87.62	105.53
Vermiwash	16.15	83.64	101.13
Matka khad	15.86	78.67	91.53
S.Em+	0.46	1.98	2.14
CD (P=0.05)	NS	5.72	6.17
CV (%)	10.01	8.69	7.85

Table 3: Effect of sulphur fertilization and foliar application of liquid manures on branches/plant at different growth stages and chlorophyll content of sesame

Treatment	Number of Branches/plant		Chlorophyll content (mg/g)
	50 DAS	At harvest	40 DAS
Sulphur levels (kg/ha)			
Control	2.53	2.73	2.02
20	2.75	3.08	2.30
40	2.95	3.37	2.53
60	3.03	3.49	2.72
S.Em+	0.07	0.08	0.05
CD (P=0.05)	0.20	0.23	0.15
Liquid manures			
Control	2.46	2.77	2.15
Panchgavya	3.00	3.37	2.50
Vermiwash	2.91	3.29	2.45
Matka khad	2.87	3.24	2.47
S.Em+	0.07	0.08	0.05
CD (P=0.05)	0.20	0.23	0.15
CV (%)	8.63	8.71	7.29

Table 4: Effect of sulphur fertilization and foliar application of liquid manures on yield attributes of sesame

Treatment	Yield attributes		
	Number of capsules/plant	Number of seeds/capsule	Test weight (g)
Sulphur levels (kg/ha)			
Control	25.0	33.7	2.23
20	26.8	36.1	2.48
40	27.9	38.4	2.68
60	28.8	39.5	2.80
S.Em+	0.7	0.8	0.07
CD (P=0.05)	1.9	2.2	0.20
Liquid manures			
Control	25.2	34.7	2.26
Panchgavya	28.4	38.6	2.77
Vermiwash	27.8	37.9	2.67
Matka khad	27.1	36.9	2.49
S.Em+	0.7	0.8	0.07
CD (P=0.05)	1.9	2.2	0.20
CV (%)	8.36	7.18	9.21

Table 5: Effect of sulphur fertilization and foliar application of liquid manures on seed, stalk and biological yields and harvest index of sesame

Treatment	Yield (q/ha)			Harvest index (%)
	Seed	Stalk	Biological	
Sulphur levels (kg/ha)				
Control	5.75	18.45	24.20	23.90
20	6.85	20.87	27.72	24.71
40	7.57	22.93	30.49	24.98
60	7.80	23.29	31.10	25.17
S.Em+	0.15	0.65	0.60	0.83
CD (P=0.05)	0.42	1.89	1.73	NS
Liquid manures				
Control	5.92	18.39	24.31	24.48
Panchgavya	7.76	23.52	31.28	24.93
Vermiwash	7.46	22.79	30.25	24.70
Matka khad	6.84	20.84	27.69	24.66
S.Em+	0.15	0.65	0.60	0.83
CD (P=0.05)	0.42	1.89	1.73	NS
Interaction	Sig.	NS	NS	NS
CV (%)	7.27	10.60	7.31	11.65

Conclusion

Based on the results of one year experimentation, it may be concluded that application of different levels of sulphur and liquid manures provide significant effect on growth and yield of sesame. Application of 40 kg sulphur per ha and two spray of panchgavya at 30 and 60 DAS produced significantly higher growth and yield attributes of sesame, hence it is more desirable and profitable for farmers.

References

1. Anonymous. Final estimates of area, production and yield of crops in respect of Rajasthan state/U.T. Directorate of Economics and Statistics, Jaipur, Rajasthan; c2021-2022.
2. Ansari AA. Effect of vermicompost and vermiwash on the productivity of spinach (*Spinacia oleracea*), onion (*Allium cepa*) and potato (*Solanum tuberosum*). World Journal of Agricultural Sciences. 2008;4(5):554-557.
3. Balasubramaniyan P, Palaniappan SP. Field crops: An overview, (In): Principles and Practices of Agronomy. Agrobios, India; c2001. p. 47.
4. Chadha S, Rameshwar A, Saini JP, Paul YS. Sustainable livelihood option for small and marginal farmers. Indian Journal of Traditional Knowledge. 2012;11(3):480-486.
5. Chandra CSB, Mehra B. Effect of foliar application of liquid organic manures and Sulphur on growth and yield of groundnut [*Arachis hypogaea* (L.)]. The Pharma Innovation Journal. 2022;11(5):1737-1740.
6. Devakumar N, Subha S, Rao GGE, Imran Khan J. Studies on soil fertility, cow urine and panchgavya levels on growth and yield of maize. Building Organic Bridges. 2014;2:627-630.
7. Jamal A, Moon YS, Abdin MZ. Sulphur-A general overview and interaction with nitrogen. Australian Journal of Crop Science. 2010;4:523-329.
8. Jat R, Naga SR, Choudhary R, Jat S, Rolaniya MK. Effect of potassium and Sulphur on growth, yield attributes and yield of sesame [*Sesamum indicum* (L.)]. Chemical Science Review and Letters. 2017;6(21):184-186.

9. Kahyaogla T, Kaya S. Modelling of moisture, color and texture changes in sesame seeds during the conventional rusting. Journal of Food and Engineering. 2006;75:167-177.
10. Mathew J, George S, Indira M. Effect of Sulphur and boron on the performance of sesame [*Sesamum indicum* (L.)] in Onattukara sandy soil of Kerala, India. Indian Journal of Agriculture Research. 2012;47(3):214-219.
11. Munji R, Babalad HB, Prasanna Kumara BH, Pushpa V. Effect of organics and fermented organics on yield, soil available N, P_2O_5, K_2O Kg/ha and microbial count in sesame. An Asian Journal of Soil Science. 2010;5(2):379-385.
12. Parmar NN, Patel AP, Choudhary M. Effect of sources and level of Sulphur on growth, yield and quality of summer sesame under south Gujarat condition [*Sesamum indicum* (L.)]. International Journal of Current Microbiology and Applied Science. 2018;7(2):2600-2605.
13. Patel JR, Shelke VB. Effect of farmyard manure, phosphorus and Sulphur on growth, yield and quality of Indian mustard. Indian Journal of Agronomy. 1995;43:713-717.
14. Patil SV, Halikatti SI, Hiremath SM, Babalad HB, Sreenivasa MN, Hebsur NS, *et al*. Effect of organics on growth and yield of chickpea [*Cicer arietinum* (L.)] in Vertisols. Karnataka Journal of Agricultural Sciences. 2012;25(3):326-331.
15. Paul SK, Khatun MM, Sarkar MAR. Effect of Sulphur on the seed yield and oil content of sesame [*Sesamum indicum* (L.)]. Journal of the Bangladesh Agricultural University. 2019;17(1):33–38.
16. Praneeth M, Singh R, Singh E. Response of late sown wheat [*Triticum aestivum* (L.)] to organic and liquid manures on yield and economics. The Pharma Innovation Journal. 2021;10(10):1488-1490.
17. Rameshwar Rana A, Thakur S, Ashlesha Paul YS, Saini JP. Effect of organic formulations on seed microflora of cereals. Plant Disease Research. 2011;26(2):180.
18. Rekha GS, Valivittan K, Kaleena PK. Studies on the influence of vermicompost and vermiwash on the growth and productivity of black gram (*Vigna mungo*). Eurasian Journal of Agricultural and Environmental Sciences 2013;13(6):783-790.
19. Shah MA, Manaf A, Hussain M, Farooq S, Hye MZ. Sulphur fertilization improves the sesame productivity and economics return under rainfed condition. International Journal of Agriculture and Biology. 2013;15:1301-1306.
20. Shariff AF, Sajjan AS, Babalad HB, Nagaraj LB, Palankar SG. Effect of organics on seed yield and quality of green gram [*Vigna radiata* (L.)]. Legume Research. 2017;40(2):388-392.
21. Shelke RI, Kalegore NK, Wayase KP. Effect of levels of phosphorus and Sulphur on growth, yield and quality of sesame [*Sesamum indicum* (L.)]. World Journal of Agricultural Sciences. 2014;10(3):108-111.
22. Venkatakrishnan L, Backiyavathy MR, Meena S, Kalaiselvi T, Amirtham D. Response of sesamum varieties to graded levels of Sulphur on seed yield and oil content in soils of different Sulphur status. Madras Agricultural Journal. 2020;107:10-12.
23. Yadav JK, Sharma M, Yadav RN, Yadav SK, Yadav S. Effect of different organic manures on growth and yield of chickpea [*Cicer arietinum* (L.)]. Journal of Pharmacognosy and Phytochemistry. 2017;6(5):1857-1860.
24. Yadav P, Yadav SS, Garg K, Athnere S, Yadav S. Effect of sulphur and zinc fertilization on productivity and economics of sesame [*Sesamum indicum* (L.)] in semi-arid conditions of Rajasthan. International Journal of Chemical Studies. 2020;8(3):675-679.