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Growth and yield parameters of mustard [*Brassica juncea* L.] as effected by different sources of organic manures, fertilizer and micronutrients

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Abstract
A field experiment entitled "Effect of Different Sources of Organic Manure, Fertilizer and Micronutrients on the Growth, Nutritional Quality and Yield parameters of Mustard [*Brassica juncea* L.]" was conducted during rabi 2022-2023 at Experimental Farm, Department of Agronomy**,** Dr. K. N. Modi University, Newai, Rajasthan. The experiment was laid out in Randomized Block Design (RBD) with 8 treatments each with three replications. The treatments were T_1 – Control, T_2 – RDF + Vermicompost @ 2.5 t ha^{-1}, T_3 - RDF + Vermicompost @ 5 t ha^{-1}, T_4 - RDF + Poultry manure @ 5 t ha^{-1}, T_5- RDF + Elemental sulphur @ 20 kg ha^{-1}, T_6 - RDF + ZnSO4 @ 20 kg ha^{-1}, T_7- RDF + FeSO4 @ 20 kg ha^{-1} and T_8 - RDF + Gypsum @ 500 kg ha^{-1}. The gross and net plot size was 4.5 m x 3.4m and 4.2 m x 3.2 m, respectively. Sowing was done on 30th October 2022.The recommended dose of fertilizer was applied as per treatments through Urea, DAP and MOP. The crop was harvested on 3rd March, 2023. The results of the experiment indicated that combined application of RDF + Vermicompost @ 5 t ha^{-1} (T_3) observed significantly maximum growth parameters *viz*., plant height, number of branches, number of leaves, leaf area and dry matter and yield and yield attributes *viz*., number of silique plant^{-1}, length of silique (cm), number of seeds silique-1, seed yield plant^{-1} (g), straw yield plant^{-1} (g), test weight (g), seed yield (kg ha^{-1}), straw yield (kg ha^{-1}) and biological yield (kg ha^{-1}), but statistically remained at par with RDF + vermicompost @ 2.5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). The application of RDF + Vermicompost @ 5 t ha^{-1} (T_3) obtained maximum net returns. Highest B:C ratio was obtained with the application of RDF + Vermicompost @ 5 t ha^{-1} (T_3). Highest oil content was recorded with RDF + Elemental sulphur @ 20 kg ha^{-1} (T_5) which was followed by T_3- RDF + Vermicompost @ 5 t ha^{-1}.

Keywords: Mustard, nutrient sources, RDF, vermicompost, gypsum

Introduction
Indian mustard (*Brassica juncea* L.) is one of the major oilseed crops and has been cultivated in India since ancient times. India is the third largest Rapeseed Mustard seed producer in the world. Mustard is an important rabi oilseed crop of India. Indian mustard, belongs to Cruciferae family and genus Brassica. Mustard has two centers of origin i.e. (1) Middle - East and India, where oldest forms are found and (2) China. Rapa. The term "Rapeseed- Mustard" is used for oilseed of genus Brassica, Eruca and Sinapsis. Of these, Brassica is most the important and has 5 species i.e., *Brassica juncea*, *B. rapa*, *B. napus*, *B. carinata* and *B. nigra*. Indian mustard is grown in rainfed condition. It requires well drained soil. and is moderately tolerant to acidic soil. It is also known as Rai, Rayda or Laha. The estimated area, production and yield of rapeseed-mustard in the world is *36.59 million hectares* (Mha), 72.37 million tones (mt) and 1980 kg / ha. globally, respectively India ranks 2nd after Canada in acreage (19.81%) and rank 4th after Canada, European Union and China in production (10.37%)

As per the COOIT data, mustard seed production was estimated at 109.5 lakh tonnes in 2021-22. The area under coverage had been pegged at 87.44 lakh hectares while the average yield was about 1,270 kg per hectare.

Rajasthan is the largest producing state in the country. Mustard seeds production is expected to increase to 49.50 lakh tones during the rabi season of 2021- 22 as against 35 lakh tones in the 2020- 2021. Rajasthan recorded the highest acreage at 39.722 lakh ha, more than 35.3 lakh ha in 2020-2021. Mustard data increased by 7.32 lakh hectare from 85.35 lakh hectare in 2021-22 to 92.67 lakh hectares in 2022-23. Thus, out of 8.20 lakh hactares increase in area under oilseeds, rapeseed and mustard alone accounted for 7.32 lakh hactares.

As per the preliminary projections, mustard seed production is likely to cross 12.5 million tonnes in the 2022-23 crop year (July, June), which is 7% more than previous year. The major producing states of rapeseed and mustard in India are Rajasthan, Uttar Pradesh, Madhya Pradesh, Punjab, Bihar, West Bengal and Assam. In Rajasthan, rapeseed and mustard occupies prime place amongst all the oilseed crops grown in the state. Rajasthan occupy 1st rank in India. It occupies 1st rank in mustard production contributing 40 percent area and 44.97 percent production of India.

Oil content in mustard varies from 37% to 49% with 14-15% carbohydrate, 25-30% protein, 10-12% fiber, 1-1.5% minerals and vitamins, 2-3% glucosinolate. Mustard oil contains about 40-60% of ericic acid, 4.5 to 13% linolenic acid and 25-30% of oleic acid.

Although balance use of fertilizers play an important role in mustard production in our country. Besides the chemical fertilizers the vermicompost organic manure and other plant nutrient in sufficient quantity also play miracle role in soil fertility, productivity and lastly production of mustard. The application of vermicompost adds plant nutrient and growth regulators. It increases soil water retention, microbial population, soil aeration, porosity, mineralization and consequently more release of available nutrients. Vermicompost application improves physical, chemical and biological properties of soil. Vermicompost is eco-friendly product which also increase soil fertility.

The application of poultry manure stimulates the soil microbial growth and activity, subsequent mineralization of plant nutrients and increases soil fertility and quality. Micronutrients are equally important in plant nutrition as the essential nutrients; Zinc is one of the essential micronutrients and plays important role in various enzymatic and physiological activities of the plant. ZnSo4 is source of Zn in mustard crop. (36.5%zinc in ZnSo4) Application of Zinc in Indian mustard increases yield from 11 to 40%. Zinc has vital role in growth, development and quality of crop. Zinc has vital role in growth, development and quality of crop. Zn influences the formation of some growth hormones in the plant like IAA and Auxin.

Sulphur is also a main micronutrient use in mustard crop for increasing oil content in mustard crop. Gypsum is use as a source of sulphur in mustard crop. as it contains 23.3% calcium and 18.6% sulphur. Sulphur is the fourth major plant nutrient after nitrogen, phosphorus and potassium for Indian agriculture. Sulphur is essential for synthesis of amino acids, protein and oil and activates enzymes system in plant. Application of sulphur in combination with balanced amounts of other nutrients significantly increases oil content and protein content of Brassica spp. It is involved in formation of chlorophyll, glucosides and glucosinolates. It is also a constituent of Vitamins, Biotine and Thiamine. Application of different sulphur fertilizers significantly increases seed yield of mustard crops ranging from 2.5 to 26.7%.

Iron has an important role in synthesis of chlorophyll and proteins. Iron in chloroplast reflects the presence of cytochrome for performing various photosynthetic. Indian are suffering from a great shortage of edible oils. The gap between production and consumption is more. There is deficiency of secondary and micronutrients in Indian soils. Productivity of mustard is very low because it is ma inly grown in rainfed condition and inadequate fertilizer deficiency of essential plant nutrients.

Therefore, I have chosen this topic of thesis so that we can find out the influence of organic manure and fertilizers and different nutrient sources on mustard crop growth and yield.

Materials and Methods

The present investigation entitled **"**Effect of different sources of organic manure, fertilizer and micronutrients on the growth, nutritional quality and yield parameters of mustard (*Brassica juncea* L.)" is carried out at Agronomy farm of the School of Agricultural Sciences, Dr. K.N. Modi University, Newai, Rajasthan during rabi season of the year 2022-23. that the soil of experimental plot was sandy loam in texture, low in available nitrogen (270.00 kg ha^{-1}), medium in available phosphorous (29 kg ha^{-1}) and medium in available potassium (268 kg ha^{-1}). The soil was moderately alkaline in reaction having pH 8.4. This soil was favourable for normal growth of the crop. Eight number of treatments and three number of replications held in 24 number of plots.

The treatments were T_1 – Control, T_2 - RDF + Vermicompost @ 2.5 t ha^{-1}, T_3- RDF + Vermicompost @ 5 t ha^{-1}, T_4 – RDF + Poultry manure @ 5 t ha^{-1}, T_5- RDF + Elemental sulphur @ 20 kg ha^{-1}, T_6 - RDF+ ZnSO4 @ 20 kg ha^{-1}, T_7- RDF + FeSO4 @ 20 kg ha^{-1} and T_8 - RDF + Gypsum @ 500 kg ha^{-1}. The gross and net plot size was 4.5 m x 3.4m and 4.2 m x 3.2 m, respectively. Sowing was done on 30th October 2022. And spacing 30 c.m. X 10 c.m. The recommended dose of fertilizer was applied as per treatments through Urea, DAP and MOP. Elemental Sulphur, ZnSO4. FeSO4 and gypsum were also applied as per treatments. Recommended practices and plant protection measures were undertaken as per recommendation. The crop was harvested on 3rd March, 2023.

Results and Discussion-Growth characters

Data regarding effect of various treatments on growth characters such as plant height, Dry matter per plant and No. of branches is presented in Table: 1.

Plant height (cm)

Data regarding effect of various treatments on mean plant height (cm) was recorded periodically during the various growth stages of crop**.** The plant height increased very fast during 31-50 DAS and slowed down during 75-90 DAS and remained constant up to harvest.

The maximum plant height 19.57, 115.18, 156.72 and 157.92 cm were recorded at 25, 50, 75 DAS and harvest stage, respectively with RDF + Vermicompost @ 5 t ha^{-1} (T_3) which was followed by RDF + Vermicompost @ 2.5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha- 1 (T_8) and it was found significantly superior over rest of the treatments at 50, 75 DAS and harvest stage. The lowest plant height was observed with control (T_1). Increase in plant height with application of RDF and vermicompost i.e., organic and inorganic sources might be due to higher nutrient supply, rigid conversion of carbohydrates into protein which in turn elaborated into protoplasm. These results corroborate with the findings of Kumar *et al*. (2018) [12] and Haque and Ali (2020) [9].

Table 1: Growth characters and yield characters affected by different treatments

S. No.	Treatments	Plant height (cm) At harvest	Dry matter accumulation (gm) per plant at harvest stage	No. of branches per plant At harvest stage	Length of silique (cm)
1.	T_1 – Control	114.83	62.85	10.25	3.65
2.	T_2 - RDF + vermicompost @ 2.5 t/ha	148.79	75.97	13.82	4.28
3.	T_3 - RDF + Vermicompost @ 5 t/ha	157.92	79.35	14.02	4.68
4.	T_4 - RDF + Poultry manure @ 5t/ha	129.09	69.50	12.15	4.05
5.	T_5 - RDF + Elemental sulphur @ 20kg/ha	124.68	66.85	10.75	3.72
6.	T_6 - RDF + ZnSO4 @ 20 kg/ha	134.97	71.09	12.28	4.08
7.	T_7 - RDF + FeSO4 @ 20 kg/ha	127.78	68.42	11.62	3.92
8.	T_8 - RDF + Gypsum @ 500 kg/ha	144.61	74.62	13.78	4.15
	SE ±	6.48	10.06	0.50	1.88
	CD at 5%	19.77	3.28	1.61	0.53

Table 2: Yield and yield attributes affected by different treatments.

S. No.	Treatments	Number of silique plant^{-1}	Number of seeds silique-1	Test weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})
1.	T_1 – Control	199.25	14.32	4.13	1173	3965
2.	T_2 - RDF + vermicompost @ 2.5 t/ha	236.45	17.15	5.11	1845	5224
3.	T_3 - RDF + Vermicompost @ 5 t/ha	263.33	17.88	5.20	2050	5777
4.	T_4 - RDF + Poultry manure @ 5 t/ha	216.02	15.28	4.50	1492	4671
5.	T_5 - RDF + Elemental sulphur @ 20 kg/ha	211.73	14.78	4.33	1463	4614
6.	T_6 - RDF + ZnSO4 @ 20 kg/ha	221.42	15.38	4.81	1589	4973
7.	T_7 - RDF + FeSO4 @ 20 kg/ha	215.81	14.98	4.44	1480	4620
8.	T_8 - RDF + Gypsum @ 500 kg/ha	234.53	17.02	5.02	1811	5167
	CD at 5%	29.83	1.99	NS	279	679
	SE ±	9.82	0.62	0.19	91	223

Number of branches plant^{-1}

Different treatments influenced on mean number of branches plant^{-1} at various growth stages of crop.

Different treatments significantly affected on number of branches plant^{-1}.

Maximum increase in number of branches was observed during 30-50 DAS.

Thereafter, number of branches increased slowly but in decreasing rate up to 75 DAS and remained constant up to harvest. Application of RDF + Vermicompost @ 5 t ha^{-1} (T_3) recorded significantly maximum number of branches and it was found at par with application of RDF + vermicompost @ 2.5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8) and found significantly superior over rest of the treatments.

The significantly lower number of branches plant^{-1} at 50, 75, DAS and at harvest were 4.62, 8.02 and 10.25, respectively observed with treatment control (T_1) at various growth stages of crop.

The increase in growth under these treatments might be attributed due to the combined effect of organic and inorganic fertilizers with which the crop was ultimately favored with better environment for proper growth and development. Such types of Results were also confined by Sharma *et al.* (2017) [28] and Singh *et al.* (2018) [33].

Dry matter accumulation plant (g)

The dry matter accumulation was increased as growth of plant increased. Faster rate of increase in dry matter production was observed at 75 DAS and harvest stage. The highest dry matter plant 1 were 2.22, 7.48, 37.32 and 79.35 g at 25, 50, 75, DAS and at harvest and recorded with application of RDF + Vermicompost @ 5 t ha (T_3) and found statistically at par with RDF + vermicompost@ 2.5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha (T_8) and significantly superior over rest of the treatments. The lowest dry matter accumulations observed due to control treatment (T_1) at 25, 50, 75, DAS and at harvest were 1.62, 5.92, 28.92 and 62.85 g, respectively**.** Photosynthetic activity and its photo morphogenesis resulted into the total dry matter production plant^{-1} (g). Due to maximum nutrient availability, the increased plant height, functional leaves and leaf area resulted into more dry matter production under nutrient management treatments. The result of the present investigation is in accordance with the findings of Beenish *et al.* (2018) [3] and Kumar *et al.* (2018) [12].

Growth Analysis: From the data on growth characters *viz*., plant height, dry matter and leaf area plant were used for the determination of various growth functions *viz*., LAI.

Yield and yield attributes

The yield and yield attributing characters *viz*., number of silique plant^{-1}, length of silique (cm), number of seeds silique-1, seed yield plant^{-1} (g), straw yield plant^{-1} (g), seed yield (kg ha^{-1}), straw yield (kg ha^{-1}) and biological yield (kg ha^{-1}) were significantly higher with the application of RDF + Vermicompost @ 5 t ha^{-1} (T_3) which was found to be at par with RDF + vermicompost @ 2.5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8). Test weight (1000 seed weight) (g) was found to be non-significant but found higher with the application of RDF + Vermicompost @ 5 t ha^{-1} (T_3). Highest harvest index was recorded with the application of RDF + Vermicompost @ 5 t ha^{-1} (T_3).

Conclusions

On the basis of present investigation, it can be concluded that, the application of RDF + Vermicompost @ 5 t ha^{-1} (T_3) recorded significantly higher growth, yield and yield attributes which was found at par with RDF + vermicompost @ 2.5 t ha^{-1} (T_2) and RDF + Gypsum @ 500 kg ha^{-1} (T_8) and found significantly superior over rest of the treatments. Highest oil content was recorded with RDF + Elemental

sulphur @ 20 kg ha^{-1} (T_5) which was followed by T_3- RDF + Vermicompost @ 5 t ha^{-1}. Significantly highest (seed yield-2050 kg ha^{-1}), GMR (Rs. 84088 ha^{-1}), NMR (Rs. 39139 ha^{-1}) and B:C ratio (1.87) was recorded with the application of RDF + Vermicompost @ 5 t ha^{-1} (T_3) which was found.

References

1. Ajnar A, Suvarna Namdeo. Effect of integrated nutrient management on Indian mustard yield attributes and yield (*Brassica juncea* L.). J Pharmacogn Phytochem. 2021;10(2):545-548.
2. Anonymous. Directorate of Rapeseed-Mustard Research. [Internet]. [cited 2021 Jan 01]. Available from: https://www.drmr.res.in/.
3. Beenish O, Ahmad L, Hussain A, Lal EP. Organic manure and biofertilizers: effect on the growth and yield of Indian mustard (*Brassica juncea* L.) varieties. Curr J Appl Sci Technol. 2018;30(04):1-7.
4. Bisht S, Saxena AK, Singh S. Effect of integrated nutrient management on growth and yield of mustard (*Brassica juncea* L.) cultivar T-9 under Dehradun region (Uttarakhand). Int J Chem Stud. 2018;6(04):1856-1859.
5. Chandra HS, Pandey G. Effect of sulphur and zinc on growth and yield of mustard (*Brassica juncea* L.). Adv Res J Crop Improve. 2017;8(02):199-202.
6. Devkota C, Prasad B, Bhattarai, Mishra SR, Ghimire P, Chaudhari D. Effect of integrated plant nutrient management on growth, yield and leaf nutrient status of broadleaf mustard (*Brassica juncea* var. rugosa). Horticulture. Int. J. 2020;4(03):78–81.
7. Gautam S, Mishra SK, Pandey HP, Pathak RK, Pandey S. Effect of nitrogen, phosphorus, potassium, sulphur and zinc on yield and their attributing characteristics of mustard crop. Int J Adv Agric Sci Technol. 2019;6(11):1-17.
8. Gour MK, Choudhary R, Jat BL. Influence of vermicompost and different nutrients on performance of Indian mustard [*Brassica juncea* (L.) Czern and Coss] in Typic Haplustepts. J Biol Sci. 2017;12(02):165-184.
9. Haque MA, Ali MM. Integrated effects of vermicompost with chemical fertilizers on the yield of mustard. Prog Agric. 2020;31(02):81-88.
10. Jat JS, Rathore BS, Chaudhary MG. Effect of sulphur and zinc on growth, chlorophyll content, yield attributes and yields of mustard (*Brassica juncea*) on clay loam soil of Rajasthan. Agres – An Int e-journal. 2012;1(01):42-52.
11. Kansotia B, Meena R, Meena VS. Effect of vermicompost and inorganic fertilizers on Indian mustard (*Brassica juncea* L.). Asian J Soil Sci. 2013;8(01):136-139.
12. Kumar A, Kumar A, Kumar P, Yogesh, Yadav LK, Kumar R. Effect of organic management practices on growth, yield attributes and grain yield in mustard [*Brassica juncea* (L.) Czern. and Coss.]. Int. J Curr Microbiol Appl. Sci. 2018a;7(09):3585-3590.
13. Kumar A, Kumar S, Kumar P, Kumar P. Effect of zinc and iron application on yield and acquisition of nutrient on mustard crop (*Brassica juncea* L.). J Plant Dev Sci. 2014;6(03):413-416.
14. Kumar V, Singh V, Singh S, Tiwari NK. Effect of macro-nutrients and farm yard manure on productivity and profitability of mustard (*Brassica juncea* L.) in Western Uttar Pradesh, India. Asian J Soil Sci Plant Nutr. 2017;1(03):1-6.
15. Lepcha S, Moinuddin DR, Bhujel K. Influence of different organic and inorganic sources of nitrogen on growth, yield and oil content of Indian mustard (*Brassica juncea* L.). J Int. Acad. Res. 2015;53(3):146-159.
16. Lim AH. Effect of poultry manure on the growth and yield of leaf mustard (*Brassica juncea*) and lettuce (*Latuca sativa*) grown on bris soil. J Trop Agric Food Sci. 2016;44(01):29-37.
17. Meena M, David AA, Kumar S. Effect of different levels of NPK and zinc sulfate on yield and oil content in mustard (*Brassica juncea* L.) var. Jai Kisan. Int J Pure Appl Biosci. 2018b;6(06):722-727.
18. Mhetre AG, Vaidya KP, Dademal AA, Kapse VD. Effect of integrated nutrient management on yield and quality of mustard (*Brassica juncea* L.) on Alfisols of Konkan (MS). Pharma Innov J. 2019;8(08):147-149.
19. Murali M, Umrao R, Kumar H. Effect of different levels of organic manure on the growth and yield of mustard (*Brassica juncea* L.) under Jatropha (Jatropha circus L.) based agroforestry system. J Pharmacogn Phytochem. 2018;7(04):955-958.
20. Nadaf S, Chandranath HT. Effect of zinc and boron on nutrient uptake, yield and quality of mustard under rainfed condition. Int. J Curr Microbiol Appl. Sci. 2019;8(06):2490-2495.
21. Parihar S, Kameriya PR, Choudhary R. Response of mustard (*Brassica juncea*) to varying levels of sulphur and fortified vermicompost under Lomay sand soil. Agric Sci Dig. 2014;34(4):296-298.
22. Premi OP, Arvind Kumar, Sinsinwar BS, Manoj Kumar. Productivity and Economics of Indian mustard [*Brassica juncea* (L). Czern & Coss] as influenced by foliar spray of Agrochemicals. J Oilseeds Res. 2005;21(2):299-300.
23. Rajput RK, Nath S, Sharma YK, Mohan B, Rajput P, Varma J, Singh R, Singh SP. Study the effect of nitrogen and sulfur levels on yield attributes, yield and quality of Indian mustard [*Brassica juncea* (L.) Czern & Coss.]. Pharma Innov J. 2018;7(03):632-634.
24. Rimi TA, Islam MM, Akter A, Islam J, Islam S, Parvin S, Ziasmin S. Evaluation of different levels of nitrogen and zinc fertilizer on morphological characters and yield of Rapeseed. Am J Plant Biol. 2020;5(01):12-26.
25. Sahoo GC, Biswas PK, Santra GH. Effect of different sources of sulfur on growth, productivity and oil content of Brassica campestris var. toria in the red soil of Odisha. Int. J Agric. Environ Biotechnol. 2017;10(06):689-694.
26. Sahu DK, Swaroop N, Prasad D, Kanwar DS, Singh P. Effect of different doses of sulfur and zinc with NPK on different growth parameters and yield attribute of yellow mustard (*Brassica compestris* L.) cv. Sunanda. Int. J Curr Microbiol Appl Sci. 2018;7(03):1014-1022.
27. Sangwan PS, Jhorar BS. Effect of soil and foliar application of zinc on seed yield of mustard, *Brassica juncea* (L) Czernj and Cosson in Typic Ustochrept soil of Hisar, Haryana. Int J Farm Sci. 2017;7(02):37-39.
28. Sharma JK, Jat G, Meena RH, Purohit HS, Choudhary RS. Effect of vermicompost and nutrients application on soil properties, yield, uptake and quality of Indian mustard (*Brassica juncea*). Ann Plant Soil Res. 2017;19(01):17–22.
29. Sharma S, Pathak RK, Pandey HP. Effect of boron, gypsum on yield and yield attributes of Indian mustard

(*Brassica juncea* L.) in amended alkali soil. Int J Chem Stud. 2019;7(06):2521-2524.
30. Singh S, Singh M. Influence of nitrogen and sulfur application on growth, yield attributes, yield and quality of mustard (*Brassica juncea* L.) in Bundelkhand region. Int J Fauna Biol Stud. 2018b;5(02):83-85.
31. Sipai AH, Sevak K, Khorajiya KU, Modi DB. Effect of sulfur and zinc with and without FYM on yield and soil physical property after harvest of mustard [*Brassica juncea* (L.) Czern & Coss] grown on light-textured soil of Kachchh. Asian J Soil Sci. 2017;12(01):10-17.
32. Soni S, Shushant, Meena LR, Kumar S. Effect of nutrient sources, gypsum and growth regulators on growth, yield and quality of Indian mustard [*Brassica juncea* (L.) Czern. and Cross] under sub-humid region of Uttaranchal. Ann Agric Res New Ser. 2016;37(02):165-170.
33. Upadhyay PK, Singh DP, Singh MP, Srivastava A. Effect of phosphorus and sulfur level on plant growth and dry matter production of mustard (*Brassica juncea* L.). Int. J Pure Appl. Biosci. 2018;6(06):751-757.
34. Verma V, Maurya CL, Tomar S, Singh RP. Effect of different levels of zinc and sulfur on morpho-physiological parameters of Indian Mustard. Int. J Curr Microbiol Appl Sci. 2018;7(07):2059-2073.
35. Yadav MS, Dhanai CS. Effect of fertilizers on yield and yield attributing characters of mustard (*Brassica juncea* L. Czern & Coss). J Pharmacogn Phytochem. 2018;7(02):2300-2303.